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EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION

Volume II: Computer Program

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FINAL REPORT

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16. Abstract

The work reported here extends that in FAA-RD-77-167, December 1977, to the problem of adjusting actual aircraft noise 1/3-octave-band spectra measured at 0.5-s intervals. Test-day spectra are used to calculate PNL, PNLT, EPNL, AL, and SEL. The test-day spectrum at the time of PNLTM and at the time of ALM are adjusted to acoustical-reference conditions using the atmospheric-absorption method in American National Standard ANS S1.26-1978 and applied, using measurements of air temperature and relative humidity at various heights above the ground, by integrating over the frequency range of the passband of ideal filters and by calculating the absorption at the exact band center frequencies only. SAE ARP866A is also used with the vertical-profile temperature/humidity data and with data at 10.0 m to determine adjustments from test to reference conditions. The adjustment methods are applied to noise data from 9 aircraft.

Volume I describes the analyses and results of the study. Volume II presents the computer program that was developed and illustrates its use with a test case. Volume III presents tables of attenuation due to atmospheric absorption over a 300-m path. Attenuations were calculated using ANS S1.26-1978 for pure tones at band center frequencies and for 3 noise spectral slopes by a band-integration method, and using SAE ARP866A. For each of the 5 methods, the tables cover 34 air temperatures from 2 to 35C, 10 relative humidities from 10 to 100 percent, and 24 nominal band center frequencies from 50 to 10,000 Hz.

17. Key Words

Atmospheric absorption of sound
Aircraft noise certification
ANSI S1.26-1978
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BEST DOCUMENT AVAILABLE

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

inches
1
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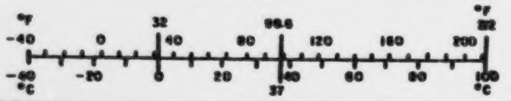
23

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION

VOLUME II: COMPUTER PROGRAM

1. INTRODUCTION

This Volume contains the source-code statements for the computer program that was prepared to perform the calculations for the analyses described in Volume I. The program was written in the extended FORTRAN IV programming language for compilation and execution on a large-scale digital computer. Input data can be entered from an interactive terminal, digital magnetic tape, or punched cards to a disk file for access during execution. Results can be output to a line printer or to an interactive terminal.

The objective of the program is to calculate adjustment factors to be applied to test-day 1/3-octave-band sound pressure levels from aircraft flyover noise measurements to account for differences in atmospheric absorption along the sound propagation path under test and acoustical-reference conditions. The band adjustment factors are calculated by four different procedures.

To achieve the objective, the program reads in measured sound pressure levels at 0.5-s intervals. From the measured sound pressure levels, the program calculates corresponding values of perceived noise levels (PNL), tone-corrected perceived noise levels (PNLT), and A-weighted sound levels (AL). The sets of PNLs, PNLTs, and sound levels are searched to find the maximum values: PNLM, PNLTM, and ALM. Effective perceived noise level (EPNL) is calculated from the set of PNLT values; sound exposure level (SEL) is calculated from the AL values. The range over which the PNLT or AL values are summed to find EPNL or SEL is determined by a specification of the 10-dB-down values from PNLTM and ALM, respectively. The time of occurrence of PNLTM and of ALM during the flyover defines the test-day spectra and propagation paths to be used in determining band adjustment factors.

To perform the atmospheric-absorption adjustments, the program reads an input data file for air temperatures and relative humidities at various heights above ground level. Barometric pressure is also read in. The air temperatures, relative humidities, and barometric pressure represent values that have been previously interpolated to the time of the flyover noise measurement.

After the test-day spectra have been adjusted to reference-day meteorological conditions by the four procedures, PNL, PNLT, and AL values are calculated from the reference-day sound pressure levels. Reference-day EPNLs are found from the reference-day PNLTMs and reference-day SELs are found from the reference-day ALMs by adding the corresponding values of test-day duration-correction factors.

As output, the program lists the measured test-day sound pressure levels and corresponding PNLs, PNLTs, and ALs, EPNLs, and SELs. Meteorological data are also listed. The adjusted reference-day sound pressure levels and corresponding PNL, PNLT, EPNL, AL, and SEL values are tabulated on separate pages. The program interrogates the input data file for another set of data until the data are exhausted.

The program was written as one main routine called TESTREF with nine subroutines. There is one labeled common block of literal data used for the legend on the final two output pages. The main routine reads in the input data, calls the subroutines to perform the calculations, and controls and specifies the output data listings.

It is noted that while the program is relatively efficient (requiring on the order of only 30 seconds of central-processor-unit time for all the calculations for one set of flyover noise measurements), greater emphasis was placed on producing an operational program that met the objective of the program than on maximizing computing efficiency. The program statements include a generous number of descriptive comments to assist the user in understanding the various steps.

The balance of this Volume contains four additional Sections. Section 2 describes and defines most of the parameters and variables used in the program along with their accompanying symbols and preferred units. Those parameters and variables not included in Section 2 are unique to a subroutine and are defined in the program statements for the subroutine. Section 2 also omits definitions for standard intrinsic FORTRAN subprograms such as ABS for the absolute-value function, COS for the cosine function, INT for the integer-part function, and LOG10 for the function to calculate base-10 logarithms. Definitions for ordinary DO-loop index counters are not included, nor are standard FORTRAN logical or arithmetic functions such as .LE. for less than or equal to, .GT. for greater than, and so on.

Section 3 contains the listing of all the program statements for the main routine and all nine subroutines. There are a total of 2024 lines of source-code for the main routine and the subroutines.

Sections 4 and 5 present the data for a sample or test case from one of the cases used for the analyses in Volume I. Section 4 contains the input data in card-image format. Section 5 contains the corresponding listings of output data.

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2. PARAMETERS AND VARIABLES USED IN MAIN PROGRAM AND SUBROUTINES

Symbols	Description and Units
AH	height, in meters, of the airplane reference point above the ground plane when over the microphone. AH is read from the input data file.
AHR	array of the average of the relative humidities, in percent, measured at two consecutive heights above ground level. The average relative humidites in AHR correspond with the average heights of the layers of the atmosphere in array HMI.
AHSAM, AHSPTM	difference between the height of the airplane and the height of the microphone at the time when (a) for AHSAM, the maximum A-weighted sound level, and (b) for AHSPTM, the maximum tone-corrected perceived noise level was noted at the microphone, m
AL	array of the A-weighted sound levels at 0.5-s intervals corresponding to the measured test-day 1/3-octave-band sound pressure levels at 0.5-s intervals during a flyover, dB
ALM	maximum value of A-weighted test-day sound levels in array AL (note that if there is more than one sound level with the same maximum value, then ALM is the one that occurs last), dB
ALMB, ALMC, ALMD, ALME	A-weighted sound levels corresponding to the reference-day spectra SPLAB, SPLAC, SPLAD, and SPLAE at the time of occurrence, at the microphone, of ALM, dB
AM	airplane flight Mach number when over the microphone. AM is read from the input data file.
AMH	distance between the airplane reference point and the microphone at the time the airplane was overhead (equal to the difference between airplane height above the ground, AH, and microphone height above the ground, ZM), m
ANSAB	name of a subroutine for calculating pure-tone atmospheric absorption coefficients, in dB/m, by the method of American National Standard ANS S1.26-1978, given the air temperature, in degrees kelvin, relative humidity, in percent, air pressure,

	in standard atmospheres, and the frequency of the sound wave in hertz
AP	ratio of the A-weighted squared sound pressure to the square of the reference pressure in a calculation of A-weighted sound level, in array AL, from a set of test-day 1/3-octave-band sound pressure levels
APMB, APMC, APMD, APME	ratios, as for AP above, except used in the calculations of ALMB, ALMC, ALMD, and ALME from reference-day spectra SPLAB, SPLAC, SPLAD, and SPLAE
APNL	name for a dummy variable used in the call for subroutine CPNL when calculating the array of test-day perceived noise levels corresponding to the 1/3-octave-band sound pressure levels, SPL(I,J), and, specifically, to the SPL spectrum ASPL(J) for a particular time index I at some 0.5-s interval after the first set of test-day data
AR	in method E for adjusting the test-day sound pressure levels to reference-day conditions, AR is the pure-tone atmospheric sound absorption coefficient, in dB/m, returned by the call for subroutine ANSAB for the defined, uniform, reference meteorological conditions with a reference air temperature of TKR = 298.15 K, a reference relative humidity of HRR = 70.0 percent, a reference air pressure of 1.0 standard atmosphere, and at the exact center frequency, FC in hertz, of a 1/3-octave band
ARP866A	name of a subroutine for calculating pure-tone atmospheric-absorption coefficients, in dB/m, applicable to 1/3-octave band sound pressure levels, according to the method of SAE Aerospace Recommended Practice ARP866A, 15 March 1975, given the 1/3-octave-band center-frequency index counter J (where J = 1 to 24 for nominal center frequencies between 50 and 10,000 Hz), the air temperature in degrees celsius, and the relative humidity in percent
AS	airplane airspeed, in m/s, when over the microphone. AS is read from the input data file.

ASPL	array of 1/3-octave-band sound pressure levels used with APNL in the call for subroutine CPNL to calculate the test-day perceived noise levels at 0.5-s intervals corresponding to the test-day sound pressure levels, SPL(I,J), dB
[illegible]	array of average air temperatures over horizontal layers of the atmosphere, with a layer defined by two consecutive heights above ground level where test-day meteorological data, appropriate for the time of the aircraft noise measurement, were measured, C
ATE	in adjustment method E, pure-tone atmospheric sound absorption coefficient, in dB/m, as in AR above but for test-day meteorological conditions along segments of the sound propagation path defined by the heights where meteorological data were measured
ATK	an array like ATC above except for air temperatures in degrees kelvin
ATTAC	in adjustment method C, attenuation, in dB, for test-day meteorological conditions over a segment of the sound propagation path as well as over the entire pathlength PDAM corresponding to the relative data-sample-time TRAM associated with the spectrum SPLAM at the time of occurrence of the maximum test-day A-weighted sound level ALM and with atmospheric absorption calculated by the method of SAE ARP866A
ATTPTC	attenuation, in dB, like ATTAC above, except for the propagation pathlength PDPTM corresponding to the relative time TRPTM associated with SPLPTM at the time of the maximum test-day tone-corrected perceived noise level PNLTM
AVALFAC	in adjustment method C, average pure-tone atmospheric sound absorption coefficient, in dB/m, applicable to a 1/3-octave band and defined by the ratio of the attenuation to the propagation pathlength (i.e., the ratio ATTAC/PDAM) and used with the atmospheric absorption coefficient RALPHA (calculated also by the method of ARP866A but for the defined, uniform, reference meteorological conditions) to determine a band-adjustment factor to be added to the test-day sound pressure levels SPLAM at the time of ALM to yield the reference-day spectrum SPLAC

AVALFPTC	like AVALFAC above, except calculated from the average attenuation ATTPTC and propagation distance PDPTM to determine the band-adjustment factor to be added to the test-day sound pressure levels SPLPTM at the time of PNLTM to yield the reference-day spectrum SPLPTC
AW	at the nominal center frequencies of the 1/3-octave bands between 50 and 10,000 Hz, a data array of 24 frequency-response weighting factors relative to the response at 1000 Hz for the A-weighting scale from the International Standard on sound level meters, dB
BAAD	array of 24 band-adjustment factors to be added to the 1/3-octave-band test-day sound pressure levels, SPLAM, at the time of ALM to determine the reference-day spectrum, SPLAD, according to adjustment method D, dB
BAAE	similar to BAAD above, except that BAAE is used to determine the reference-day spectrum, SPLAE, according to adjustment method E, and except that BAAE is not an array but a variable determined anew for each of the 24 bands, dB
BAPTD	an array like BAAD above, except that the band-adjustment factors are to be added to the test-day spectrum, SPLPTM, at the time of PNLTM to determine the reference-day spectrum, SPLPTD, according to adjustment method D, dB
BAPTE	similar to BAPTD above, except that BAPTE is used to determine the reference-day spectrum, SPLPTE, according to adjustment method E, and, like BAAE, except that BAPTE is not an array but a variable determined anew for each of the 24 bands, dB
BP	barometric pressure of the air (usually at a height of 10 m above ground level) and read from the file of input data, in. Hg
C	array, one for each set of test-day 1/3-octave-band sound pressure levels at 0.5-s intervals, of the maximum values of the tone-correction factors, in dB, calculated, according to the rules of the 3 April 1978 amendment to FAR Part 36, by procedures in subroutine P36TC when P36TC is passed a set of test-day sound pressure levels in dummy array ASPL(J). Subroutine P36TC returns the maximum tone-

	correction factor C(I) for the spectrum ASPL(J) at each relative-time index counter, I.
CMX	CMX is the name used in subroutine P36TC for the maximum tone-correction factor, in dB, in a calculation of tone-corrected perceived noise level for any set of sound pressure levels
CMXB, CMXC, CMXD, CMXE	maximum tone-correction factor returned by subroutine P36TC when passed the spectra SPLPTB, SPLPTC, SPLPTD, and SPLPTE, respectively, dB
CPNL	name of a subroutine that accepts an array of 24 1/3-octave-band sound pressure levels at nominal band center frequencies from 50 to 10,000 Hz and calculates the corresponding perceived noise level, PNL, using data constants from SAE ARP865A, 15 August 1969
DAM	array of the lengths, in meters, of the segments along the sound propagation path from the aircraft reference point to the microphone at the time of the maximum A-weighted sound level, ALM, for test-day atmospheric conditions. Segment lengths are determined from the thickness of the horizontal layers of the atmosphere defined by two consecutive heights above ground level where test-day meteorological data were measured, by the sound propagation angle relative to the flight path direction $\psi_{A,max}$ at the time of ALM, and by the flight path angle, γ, relative to the horizontal. These angles are called PSIAM and GAMAR in the program statements and in this symbol list.
DATA10	subroutine INTEG numerically integrates, over a specified duration, a set of specified input data, in dB, that vary with time. The input data can be any desired physical variable, but, in program TESTREF, subroutine INTEG is used to numerically integrate, by a summation process, (1) the tone-corrected perceived noise level, PNLT, to determine the effective perceived noise level, EPNL, and (2) the A-weighted sound level, AL, to determine the sound exposure level, SEL. The limits of the numerical integration are specified by the value of DATA10 which is 10.0 dB less than the corresponding maximum value of the input data, i.e., DATA10 = PNLTM - 10.0 or ALM - 10.0, in dB.

DATE	a number, defined to be an integer (not a real) constant that is read from the file of input data giving the day of the month when the flyover noise measurements were recorded. DATE is used for label information on the output pages for the test-day sound pressure levels.
DB	DB is the distance measured along the aircraft's flight path between the overhead point and the position of the aircraft reference point at the point of closest approach to the microphone, m
DCF	duration correction factor in the formulation of EPNL and determined for the test-day data from DCF = EPNL - PNLTM, dB
DM	minimum distance between the microphone and the aircraft flight path (at the closest point of approach), m
DOAM	distance, in meters, along the flight path from the overhead point to the position of the aircraft reference point at the relative time TRAM corresponding to the maximum test-day A-weighted sound level, ALM
DOPTM	distance, in meters, like DOAM above, except at the relative time TRPTM of the maximum test-day tone-corrected perceived noise level, PNLTM
DPTM	like DAM above, an array of segment lengths, in meters, along the sound propagation path, except at the time of PNLTM and at propagation direction angle $\psi_{PNLT,max}$ or PSIPTM
DSEL	duration of the sound exposure level, SEL, and, like DCF above for EPNL, the difference between SEL and ALM, dB
EPNL	effective perceived noise level, in dB, as calculated by subroutine INTEG from test-day PNLT data with the corresponding value of PNLTM as DATA10 and with specified values for IFP, ILP, and NS
EPNLB, EPNLC, EPNLD, EPNLE	effective perceived noise level, in dB, calculated from PNLTMB + DCF, PNLTMC + DCF, PNLTMD + DCF, and PNLTME + DCF, respectively, where DCF is the duration-correction factor for the test-day PNLT values and PNLTMB to PNLTME are the tone-corrected perceived noise levels for the reference-day spectra SPLPTB to SPLPTE

FC	exact center frequency, in Hz, of a 1/3-octave-band filter. FC is calculated from $10^{ISBN/10}$ using the international standard band numbers (ISBN) that range from 17 for the 50-Hz band to 40 for the 10,000-Hz band.
FMX	array of nominal center frequencies, in kHz, of the 1/3-octave bands that yielded the largest tone-correction factors, C(I), for the test-day sound pressure levels, SPL(I,J). For each SPL spectrum, the band level that produced C(I) is identified by frequency-band index counter JMX in order to locate the nominal band center frequency FMX in the data array FREQ.
FMXB, FMXC, FMXD, FMXE	nominal center frequencies for the bands producing the reference-day tone-correction factors CMXB to CMXE, kHz
FREQ	a data array consisting of the 24 nominal center frequencies, in Hz, of the 1/3-octave-band filters and ranging from 50 to 10,000 Hz. The frequencies in array FREQ are declared to be integer constants.
GAMAD	angle γ, or gamma, in degrees. Angle γ is the acute angle the aircraft flight path makes with the local horizontal. For calculation purposes, the engine thrust axis is assumed to be parallel to the flight path. Angle γ is positive for climbing flight, negative for descending flight, and is measured relative to the direction of flight.
GAMAR	angle γ in radians
GROUND	array of literal characters read from the input data file that gives a description of the type of ground surface that was under the microphone at the time of the test (e.g., asphalt or concrete). The description is used as label information for the output pages containing the test-day sound pressure levels.
HM	array of heights, in meters, above ground level where the input meteorological data were measured. Array HM is read from the input data file.

HMEA	array of the measured or test-day values of the atmospheric humidity, expressed as the molar concentration of water vapor in percent, and determined at the average heights in array HMI for the average test-day temperatures in array ATK, the average relative humidities in array AHR, and an air pressure of 1.0 standard atmosphere. At each increment of height, the humidity values in the array HMEA are calculated by calling subroutine MOLAR.
HMI	array of heights that are midway between two consecutive heights where meteorologicsl data were measured, (i.e., the average height above the ground plane for each layer of the atmosphere), m
HR	array of test-day relative humidities, in percent, measured at the heights in array HM and read from the input data file
HREF	array of atmospheric humidities, expressed as the molar concentration of water vapor, in percent, like the humidities in array HMEA and at the same heights, but calculated for defined, reference lapse rates of air temperature, relative humidity, and pressure rather than the measured test-day temperatures and relative humidities and a constant air pressure of 1.0 standard atmosphere. Subroutine MOLAR is called to calculate the values of HREF at each increment of height.
HRR	reference-day relative humidity for a uniform atmosphere and set equal to 70.0 percent
HR10	relative humidity for the test-day conditions interpolated, or read directly, from the measured vertical-profile meteorological data for a height of 10.0 m, percent.
IAM	index from the relative test-time indexes, I, in the array of relative test times TT(I) for that value of the A-weighted sound level selected from the set of sound levels, AL(I), and identified as the maximum A-weighted sound level, ALM, i.e., AL(I) = AL(IAM) = ALM. If, in the search from the first to the last relative time (over the index range from I = 1 to I = NS), more than one AL value has the same maximum value, then IAM is set equal to the last value or the last time when AL = ALM.
IE, IS	relative-time index counters used for identifying and printing out the columns of test-day sound pressure levels, perceived noise levels,

	tone-corrected perceived noise levels, and FMX values. Initially, IS = 1 and IE = 14 to print out 14 samples at 0.5-second intervals on the first page corresponding to relative test times TT(1) = 0.0 to TT(14) = 6.5. IS and IE, for I Start and I End, are incremented by appropriate values until all data samples have been listed, i.e., at IE = NS.
IFA, IFP, ILA, ILP	relative-time index counters determined by subroutine INTEG for the first and last times when the test-day A-weighted sound level AL(I) is closest to ALM - 10.0 (i.e., IFA and ILA), or when the test-day tone-corrected perceived noise level PNLT(I) is closest to PNLTM - 10.0 (i.e., IFP and ILP). The index counters are used to denote the relative times on the output page for beginning and ending times in the calculation of duration correction factors for EPNL and SEL; DCF is calculated for times ranging from TT(IFP) to TT(ILP) and DSEL is for times from TT(IFA) to TT(ILA) where TT(I) is the array of relative test times at 0.5-s intervals.
INTEG	name of a subroutine that performs a numerical integration, by a simple summation of rectangular approximations, of the square of a quantity, derived from an array of input values in decibels, over a range of relative test times which are the first and the last times when the input data are closest to DATA10. The answer returned by INTEG is called SUMDAT for the power sum of the input data.
IPM, IPTM	like IAM above, except the relative time indexes for that value of PNL(I) which is set equal to PNLM and for that value of PNLT(I) which is set equal to PNLTM
ISBN	international standard band numbers for 1/3-octave-band filters, see FC above. ISBN is defined to be a real (not an integer) variable.
JMX, JMXB, JMXC, JMXD, JMXE	frequency band index counters returned by subroutine P36TC in a calculation of tone-corrected perceived noise level and used to determine the nominal center frequency of the 1/3-octave band that produced the largest tone-correction factor [C(I) or CMXB to CMXE depending on which set of sound pressure levels were being examined]. The nominal band center frequencies associated with the maximum

	tone-correction factors are found from FMX = FREQ(JMX), FMXB = FREQ(JMXB), FMXC = FREQ(JMXC), and so on. See descriptions of C(I), FMX, and FREQ.
KAA, KAP	for the propagation distances at the time of maximum test-day A-weighted sound level, ALM, and at the time of maximum test-day tone-corrected perceived noise level, PNLTM, and for the corresponding heights of the aircraft reference point above the microphone height, AHSAM and AHSPTM, index counters KAA and KAP represent the heights from the array HM(K) of heights for meteorological data which are equal to, or just less than, the corresponding height of the aircraft reference point above the microphone height, i.e., KAA = K - 1 when [HM(K) - ZM] is first greater than AHSAM in a search from K = 1 to K = NH and correspondingly for KAP when [HM(K) - ZM] is first greater than AHSPTM.
KAA1, KAP1	like the height-array index counters KAA and KAP defined above, except that KAA1 = KAA - 1 and KAP1 - KAP -1 to specify those heights from the HM(K) array which are stored in the locations that are 1 less than the locations defined by KAA and KAP
KK	index of the height array HM(K) when HM(K) is first greater than the microphone height ZM in a search from 1 to NH. To find the lengths of the propagation-path segments in arrays DAM(K) and DPTM(K), index KK is used as the starting index for calculations backwards along the sound propagation path from the microphone to the aircraft reference point.
KLA, KLP	final indexes of the propagation-pathlength-segment arrays DAM(K) and DPTM(K) for the last segment of the path from the microphone back to the aircraft reference point: KLA = KAA1 - KK + 3 and KLP = KAP1 - KK + 3. Indexes KLA and KLP are used in the layered-atmosphere procedures of methods C, D, and E to define the range of steps in the calculation of the test-day attenuation over the propagation path in each frequency band.

LPAGE, LPGTOT	page number counters used to label the pages of the output listing the test-day sound pressure levels at 0.5-s intervals and the associated values of PNL, PNLT, AL, and FMX. LPGTOT is the total number of pages of input data, printed with a maximum of 14 columns of SPL per page, and LPAGE is the running page number counter with a value between 1 and LPGTOT.
MIC	abbreviation for microphone number, a label assigned during the flyover noise measurement to identify the microphone and its location. MIC is read in from the input data file and is only used to label the output pages.
MOLAR	name of a subroutine that calculates the humidity of the atmosphere as the molar concentration of water vapor, in percent, given the air temperature, in degrees kelvin, relative humidity, in percent, and air pressure, in standard atmospheres
MONTH	integer array read in from the input data file and consisting of one 4-character computer word giving the month of the year when the flyover noise data were measured (e.g., OCT or JAN). MONTH, DATE, and YEAR are used as label information for the output pages containing the test-day sound pressure levels.
NH	integer constant read in from the input data file that specifies the total number of heights (in array HM) where the test-day meteorological data (in arrays TC and HR) were measured
NPG	symbol for an integer variable used in the DO loop for printing out pages 2 and 3 of the summary output pages. Information on page 2 (the EPNL page) is printed when NPG = 1, that on page 3 (the SEL page) when NPG = 2.
NS	integer constant read from the input data file to specify the total number of 0.5-s samples of test-day 1/3-octave-band sound pressure levels which are available and are to be read in from the input data file as the array SPL(I,J) where I ranges from 1 to NS for the time index and J ranges from 1 to 24 for the frequency-band index
NUMINT	name of a subroutine that performs the numerical integrations in method D for determining the 1/3-octave-band adjustment factors for the differences in attenuation over the propagation pathlength as a

result of differences in atmospheric absorption under test and reference meteorological conditions. NUMINT returns an array of the band-adjustment factors, in dB, given: (1) an array of 24 test-day sound pressure levels in dB, (2) the reference-day uniform-atmosphere air temperature, TKR, in degrees kelvin, (3) the reference-day uniform-atmosphere relative humidity, HRR, in percent, (4) the reference-day uniform-atmosphere air pressure, PAR, in standard atmospheres, (5) the array of average test-day air temperatures, ATK, in degrees kelvin, (6) the array of average test-day relative humidities, AHR, in percent, (7) the test-day atmospheric pressure, PA, in standard atmospheres, (8) the array of propagation-pathlength segments along the sound propagation path from the microphone back to the aircraft reference point, and (9) the index counter for the last segment in the array of propagation path segments. If the array of test-day sound pressure levels is given by SPLPTM(J), with the array of propagation path segments given by DPTM(K) and the last index counter specified by KLP, then NUMINT returns the array of band-adjustment factors BAPTD(J). Similarly, SPLAM(J) with DAM(J) and KLA returns the array BAAD(J).

PA	test-day atmospheric pressure, in standard atmospheres, calculated from BP/RBPO and assumed to be uniform over the sound propagation path
PAR	reference-day air pressure for a uniform atmosphere and set equal to 1.0 standard atmosphere
PDAM, PDPTM	total propagation distance from the aircraft reference point to the microphone at the relative time of occurrence of ALM with sound directivity angle PSIAM for the distance PDAM, and at the relative time of occurrence of PNLTM with sound directivity angle PSIPTM for the distance PDPTM, m
PHIAM, PHIPTM	angle ϕ (or PHI) defines the location of the aircraft on the flight path at the relative time of occurrence at the microphone of ALM and PNLTM, respectively. Angle ϕ, in radians, is measured, relative to the direction of flight, between the flight path and the line from and aircraft reference point to the microphone.
PI	3.141592654 radians (360°)

PNL	array of perceived noise levels at 0.5-s intervals corresponding to the test-day sound pressure levels in array SPL, dB
PNLM	maximum value of test-day perceived noise levels in array PNL (the last one if there is more than one PNL with the same maximum value), dB
PNLMB, PNLMC, PNLMD, PNLME	similar to ALMB to ALME above, except for perceived noise levels instead of A-weighted sound levels and except that the test-day spectrum SPLPTM at the time of occurrence at the microphone of PNLTM is adjusted to reference-day conditions by methods B, C, D, and E to yield the spectra SPLPTB to SPLPTE from which the perceived noise levels PNLMB to PNLME are calculated, dB
PNLT	array of tone-corrected perceived noise levels corresponding to the array of test-day sound pressure levels in array SPL and perceived noise levels in array PNL, dB
PNLTM	maximum value of test-day tone-corrected perceived noise levels in array PNLT (the last one if there is more than one PNLT with the same maximum value), dB
PNLTMB, PNLTMC, PNLTMD, PNLTME	similar to PNLMB to PNLME above except for tone-corrected perceived noise levels in dB. The values are found from PNLTMB = PNLMB + CMXB, PNLTME = PNLMC + CMXC, etc.
PSIAM, PSIPTM	at the same relative times as for angles PHIAM and PHIPTM above, but for the sound directivity angles PSIAM and PSIPTM between the flight path and the line to the microphone from the point on the flight path where the aircraft reference point was when the aircraft emitted the sound which resulted in the value of ALM or PNLTM, radians. Note that PSIAM = PHIAM - $\sin^{-1}$[AM sin (PHIAM)] and PSIPTM = PHIPTM - $\sin^{-1}$[AM sin (PHIPTM)].
P36TC	name of a subroutine that calculates tone-correction factors according to the April 1978 version of Part 36 of the Federal Aviation Regulations. Given a spectrum of 24 1/3-octave-band sound pressure levels, P36TC returns the maximum value of the tone-correction factors for that spectrum and the corresponding frequency-band index counter [e.g., C(I) and JMX are returned for

	each of the SPL(I,J) spectra [or each ASPL(J)], CMXB and JMXB for SPLPTB(J), etc.]
RALPHA	for each 1/3-octave band, the reference-day sound absorption coefficient calculated by subroutine ARP866A for uniform reference meteorological conditions with air temperature given by TCR and relative humidity given by HRR and used in finding the band-adjustment factors in methods B and C, dB/m
RBPO	reference, sea-level, standard-day barometric pressure of 29.921 in. Hg and used with BP to determine PA
RHM	reference height above ground level fo 10.0 m used to define the starting height for the calculations of reference vertical profiles of reference air temperature RTK, reference relative humidity RHR, and reference air pressure RPA
RHR	array for the reference vertical profile of relative humidity starting from a value set by RHRO at the reference height RHM and decreasing at the rate specified by RHRL, percent
RHRL	reference lapse rate for the reference relative humidities in array RHR with the value of -0.0065 percentage points/m (-6.5 percentage points/km)
RHRO	reference relative humidity, at the reference height RHM, with the value of 70.0 percent
RPA	array for the reference vertical profile of air pressure starting from a value of 1.0 standard atmosphere at the reference height RHM, standard atmospheres
RPAL	exponent for the lapse rate of air pressure in standard atmospheres or a range of heights from mean sea level to 11 km and having the value of -5.25588
RTK	array for the reference vertical profile of air temperature starting from a value set by RTKO at the reference height RHM and decreasing at the rate specified by RTKL, K
RTKL	reference lapse rate for the reference air temperatures in array RTK with the value -0.0065 K/m (-6.5 K/km)

RTKO	reference air temperature at the reference height RHM with the value of 298.15 K (i.e., 25.0 C)
RUN	integer constant that is read from the input data file to specify the run number assigned at the time of the measurements to the set of input test-day sound pressure levels and used for label information on the output pages
SEL	sound exposure level, in dB, as calculated by subroutine INTEG from test-day AL data with the corresponding value of ALM as DATA10 and with specified values for IFA, ILA, and NS
SELB, SELC, SELD, SELE	sound exposure levels, in dB, calculated from the SEL duration factor, DSEL, and the maximum A-weighted sound levels for reference-day meteorological conditions by methods B to E: SELB = ALMB + DSEL, SELC = ALMC + DSEL, etc.
SPL	a 2-dimensional array SPL(I,J) representing the test-day sound pressure levels read from the input data file at the I-intervals of time during the flyover noise recording for the J 1/3-octave bands, dB
SPLAB, SPLAC, SPLAD, SPLAE, SPLAM	SPLAM represents the array of 24 1/3-octave-band test-day sound pressure levels that are associated with the maximum test-day A-weighted sound level, ALM; SPLAB to SPLAE represent the corresponding arrays of sound pressure levels adjusted to uniform reference-day conditions by adjustment methods B to E, respectively, dB
SPLPTB, SPLPTC, SPLPTD, SPLPTE, SPLPTM	SPLPTM represents the array of 24 1/3-octave-band test-day sound pressure levels that are associated with the maximum test-day tone-corrected perceived noise level, PNLTM; SPLPTB to SPLPTE represent the corresponding arrays of sound pressure levels adjusted to uniform reference-day conditions by adjustment methods B to E, respectively, dB
SUMDAT	SUMDAT is the value of the summation returned by subroutine INTEG as the nondimensional power sum $\sum_{i} 10^{[DATA(I)]/10}$ between the values of the test-day times when DATA is closest to DATA10. If DATA is the array of PNLT values and DATA10 = PNLTM - 10.0, then SUMDAT is used to determine EPNL; if DATA is the array of AL values and DATA10 = ALM - 10.0, then SUMDAT is used to determine SEL.

TALM	a quantity used with the output listing of test-day sound pressure levels to indicate the time of occurrence of ALM. TALM, in seconds, is determined by the value of the relative test time from array TT(I) at the index IAM [i.e., TALM = TT(IAM)].
TALPHA	for band-adjustment method B, an absorption coefficient calculated by subroutine ARP866A at a frequency defined in the subroutine for the air temperature and relative humidity TC10 and HR10 at a height of 10.0 m, dB/m
TC	array of test-day air temperatures measured at the heights defined by array HM and read from the input data file, C
TCR	reference-day air temperature for a uniform atmosphere and set equal to 25.0 C
TC10	air temperature for test-day conditions interpolated, or read directly, from the measured vertical-profile data for a height of 10.0 m, C
TEXT, TEXTA	names for the two arrays of literal characters that are declared to be labeled COMMON and which are defined in BLOCK DATA for use on summary output pages 2 and 3. The 372-computer-word array TEXT is a 12x31, 2-dimensional array of 12 computer words on 31 lines of descriptive text. Each line has a maximum of 48 literal characters at 4 characters per computer word. There are 31 possible lines of text to correspond with the data at the 24 1/3-octave-band center frequencies with an allowance for 7 blank lines that are used for spacing when printing the output listings. TEXTA is a 12-computer-word, one-dimensional array that is used in place of TEXT(12,3) when printing the third line of descriptive text on page 3 of summary output. Page 3 contains the values of maximum A-weighted sound level and sound exposure level while page 2 contains the perceived noise levels and effective perceived noise levels.
TITLE1, TITLE2	arrays of 20 4-character computer words that are read from the input data files and used for titles on the output pages. TITLE1 is used on the pages containing the input test-day sound pressure levels and describes general characteristics for the type of aircraft

	tested. TITLE2 is used on the test-day SPL pages and also on pages 2 and 3 of the summary output pages to describe particular characteristics of the aircraft, engine, and test-site location.
TKR	reference-day air temperature for a uniform atmosphere and set equal to 298.15 K
TOH	time, in seconds, on the day of the test when the aircraft was directly over the microphone (i.e., the time at overhead). TOH is read from the input data file as the time after midnight on the basis of 86,400 seconds per day (e.g., TOH = 44184 s means 12 hours, 16 minutes, and 24 seconds after midnight or 1216:24 hours).
TPNLM, TPNLTM	similar to TALM above, except here the symbols indicate the relative times, in seconds, from array TT at the time of occurrence of PNLM [TPNLM = TT(IPM)] and of PNLTM [TPNLTM = TT(IPTM)].
TRAM, TRPTM	relative times of occurence, in seconds, of ALM and PNLTM. The relative times are determined relative to the time of day TOH when the aircraft was directly over the microphone and the time TS of the first sample of test-day sound pressure level. A 0.25-s factor is included in the calculation of TRAM and TRPTM to shift the relative time scale to the center of the 0.5-s data sample; thus TRAM = TS + 0.25 + TT(IAM) - TOH and TRPTM = TS + 0.25 + TT(IPTM) - TOH.
TS	time of day, in seconds, read from the input data file and defined as the time at the beginning of the first 0.5-s sample of test-day sound pressure levels [i.e., at the start of the first relative test time TT(1)], and, like TOH, on a 86,400-s daily basis
TT	array of times associated with each set of test-day sound pressure levels, seconds. The test times in array TT are determined relative to 0.0 seconds at the midpoint of the averaging period for the first data sample. For computational purposes, each data sample was considered to have been averaged for exactly 0.5 seconds.
YEAR	a number, declared to be an integer constant, read from the input data file (e.g., as 74 or 76) and used with DATE and MONTH for specifying when the flyover noise measurements were made

ZM	height of the microphone above the ground plane for the flyover noise measurements and read from the input data file, m

3. LISTING OF PROGRAM STATEMENTS

TESTREF is the name for the main, or driver, program that calculates spectral adjustment factors for differences in atmospheric absorption. The program is specifically applicable to aircraft noise measurements made under test conditions and adjusted to reference meteorological conditions. Four separate adjustment procedures are included.

The program reads in 1/3-octave-band sound pressure levels at regular intervals of time during a recording of aircraft flyover noise. Meteorological and other associated test data are also read in. The required calculations are performed by nine subroutines that are called by the main program. An array of labeled common is included as BLOCK DATA and contains the text of explanatory legends for some of the tabular output listings.

Program TESTREF and the BLOCK DATA require about 6825 words or 28,000 bytes of source-code storage capacity. With subroutines, approximately 37,500 bytes are required for storage of the total source code.

The total number of lines of computer program coding are substantially more than required for reading in the data, performing the calculations, and printing the output pages. To assist the user, several comments have been included in the main program and subroutines to explain and describe the methods used and options selected.

The program was written in the FORTRAN IV-extended programming language. It was written for a compiler and central processer that are compatible with an IBM System 370 computer. The program makes use of certain features permitted by the compiler that may not be available on another machine. For the user's information, those features that may require special attention during implementation of the program are listed below.

1. Extended assignment of a value to several variables simultaneously is permitted, as A = B = C = D = E = 0.0.

2. GOTO is a permitted format; GO TO is not required.

3. LOG10 and LOG are permitted forms; ALOG10 and ALOG are not required for logarithms.

4. ASIN is permitted for the arcsine; ARSIN is not required.

5. The name of a function or a variable can have as many as 8 characters; some systems have a limit of 6 characters.

6. Arithmetic operations are permitted in the range of a DO loop and in the specification of a READ or WRITE statement, as DO 20 J = 1, 3*NN or READ (5, 15) TC + 273.15.

7. Two or more statements can be combined on one line, but separated by semicolons as PNM = -10.0; PNT = 0.0.

BEST DOCUMENT AVAILABLE

```
C**   PROGRAM TESTREF
C
C     PROGRAM TESTREF WAS PREPARED BY DYTEC ENGINEERING, INC. OF
C     LONG BEACH, CA.  VERSION 12 AUGUST 1979.
C
C     THE PURPOSE OF THE PROGRAM IS TO ADJUST MEASURED AIRCRAFT
C     FLYOVER NOISE LEVELS FOR DIFFERENCES IN ATMOSPHERIC ABSORPTION
C     LOSSES UNDER TEST AND REFERENCE METEOROLOGICAL CONDITIONS.
C
C     ADJUSTMENTS ARE DETERMINED USING PURE-TONE ATMOSPHERIC
C     ABSORPTION CALCULATED BY THE PROCEDURES OF SAE ARP 866A (MARCH
C     1975) AND ANS S1.26-1978.  ABSORPTION LOSSES AND ADJUSTMENTS
C     FROM TEST TO ACOUSTICAL REFERENCE METEOROLOGICAL CONDITIONS
C     FOR 1/3-OCTAVE-BAND SOUND PRESSURE LEVELS ARE CALCULATED
C     BY A NUMBER OF METHODS.
C
C     THE EFFECT OF USING THE VARIOUS METHODS IS DETERMINED FOR
C     1/3-OCTAVE-BAND SOUND PRESSURE LEVELS, PERCEIVED NOISE LEVELS,
C     TONE-CORRECTED PERCEIVED NOISE LEVELS, EFFECTIVE PERCEIVED
C     NOISE LEVELS, MAXIMUM A-WEIGHTED SOUND LEVELS, AND SOUND
C     EXPOSURE LEVELS.  VARIOUS AIRCRAFT NOISE SPECTRA, SOUND
C     PROPAGATION DISTANCES, AND TEST-DAY METEOROLOGICAL CONDITIONS
C     ARE EXAMINED BY VARYING THE INPUT DATA.
C
C*******************************************************************
C
C**   INPUT DATA FILE:
C
C     FOR EACH SET OF INPUT DATA, THE INPUT FILE THAT IS READ ON
C  DEVICE 5 CONTAINS:  RUN; MIC, NS, DATE, MONTH, AND YEAR;
C  TS, TOH, AH, ZM, AS, AM, AND GAMAD; SPL; NH AND HM; TC AND HR;
C  BP; AND TITLE1, TITLE2, AND GROUND FOR LABELS ON OUTPUT PAGES.
C
C**   SYMBOLS AND UNITS FOR PARAMETERS AND VARIABLES ARE DEFINED
C  IN COMMENTS AND IN ACCOMPANYING TEXT IN MORE DETAIL.
C
C*********************************************************************
C
      DIMENSION AHR(31),AL(100),ASPL(24),ATC(31),ATK(31),AW(24),
     1BAAD(24),BAPTD(24),C(100),DAM(31),DPTM(31),FMX(100),FREQ(24),
     2GROUND(5),HM(31),HMEA(31),HMI(31),HR(31),HREF(31),MONTH(1),
     3PNL(100),PNLT(100),RHR(31),RPA(31),RTK(31),SPL(100,24),
     4SPLAB(24),SPLAC(24),SPLAD(24),SPLAE(24),SPLAM(25),SPLPTB(24),
     5SPLPTC(24),SPLPTD(24),SPLPTE(24),SPLPTM(25),TC(31),TT(100),
     6TITLE1(20),TITLE2(20)
C
C     THE DIMENSIONS OF AHR,ATC,ATK,DAM,DPTM,HM,HMEA,HMI,HR,
C  HREF,RHR,RPA,RTK, AND TC ARE SPECIFIED FOR METEOROLOGICAL
C  MEASUREMENTS AT 31 HEIGHTS ABOVE GROUND.  IF THERE ARE MORE
C  HEIGHT INTERVALS (LAYERS) THAN 31, THE DIMENSION WILL HAVE
C  TO BE INCREASED ACCORDINGLY, HERE AND IN CORRESPONDING SUBROUTINES.
C
```

```
      COMMON /CTEXT/ TEXT(12,31),TEXTA(12)
      INTEGER DATE,FREQ,RUN,YEAR
      REAL ISBN
C
C     DATA FREQ = 24 NOMINAL 1/3-OCTAVE-BAND CENTER FREQUENCIES
C
      DATA FREQ /50,63,80,100,125,160,200,250,315,400,500,630,800,
     11000,1250,1600,2000,2500,3150,4000,5000,6300,8000,10000/
C
C     DATA AW = A-SCALE FREQUENCY WEIGHTINGS AT THE 24 CENTER
C     FREQUENCIES OF THE 1/3-OCTAVE BANDS.
C
      DATA AW /-30.2,-26.2,-22.5,-19.1,-16.1,-13.4,-10.9,-8.6,
     1-6.6,-4.8,-3.2,-1.9,-0.8,0.0,0.6,1.0,1.2,1.3,1.2,1.0,
     20.5,-0.1,-1.1,-2.5/
C
C**** READ INPUT FILE FOR AIRCRAFT NOISE LEVELS AND ASSOCIATED DATA
C
C     READ RUN,MIC,NS,DATE,MONTH,YEAR,TS,TOH,AH,ZM,AS,AM, AND
C   GAMAD.
C
      READ (5,10) RUN
   10 FORMAT (I3)
   11 READ (5,12) MIC,NS,DATE,MONTH,YEAR
   12 FORMAT (I1,I4,I3,1A4,I3)
      READ (5,13) TS,TOH,AH,ZM,AS,AM,GAMAD
   13 FORMAT(F7.1,F8.1,F6.1,F4.1,F5.1,F6.3,F5.1)
C
C     CALCULATE TT(I), THE ARRAY OF TEST TIMES RELATIVE TO THE
C     TIME OF THE FIRST DATA SAMPLE ASSUMING DATA TIME INTERVALS
C     OF EXACTLY 0.5 SECONDS.
C
      TT(1)=0.0
      DO 14 I=2,NS
   14 TT(I)=TT(I-1)+0.5
C
      DO 25 I=1,NS
C
C     READ SPL(I,J), THE 24 1/3-OCTAVE-BAND SPLS AT 0.5-S INTERVALS.
C
      READ (5,15) (SPL(I,J),J=1,24)
   15 FORMAT(12F6.1)
C
      DO 17 J=1,24
   17 ASPL(J)=SPL(I,J)
C
C     CALCULATE PERCEIVED NOISE LEVEL, PNL(I)
C
      CALL CPNL(ASPL,APNL)
      PNL(I)=APNL
C
C     CALCULATE TONE-CORRECTED PERCEIVED NOISE LEVELS, PNLT(I)
C
      CALL P36TC(ASPL,C(I),JMX)
      PNLT(I)=PNL(I)+C(I)
C
```

```
C        FIND FMX(I), THE NOMINAL CENTER FREQUENCY IN KHZ OF THE
C     BAND THAT PRODUCED CMX AND HAD FREQUENCY BAND INDEX COUNTER
C     JMX.
C
         FMX(I)=(FLOAT(FREQ(JMX)))/1000.0
C
C        CALCULATE A-WEIGHTED SOUND PRESSURE LEVEL, AL(I).
C        SET AL(I)=0.0 DB IF ALL SPL(J)=0.0 DB.
C
         AP=0.0
         DO 20 J=1,24
   20    AP=AP+10.0**((SPL(I,J)+AW(J))/10.0)
         IF(AP.LT.15.0)GOTO 23
         AL(I)=10.0*LOG10(AP)
         GOTO 25
   23    AL(I)=0.0
   25    CONTINUE
C
C        FIND PNLM, THE MAXIMUM VALUE OF THE PERCEIVED NOISE LEVELS
C        PNL(I); IPM, THE TIME INDEX COUNTER WHEN PNL(I)=PNLM; AND
C        TPNLM, THE RELATIVE TEST TIME TT(IPM) WHEN I=IPM.
C
C        FIND PNLTM, THE MAXIMUM VALUE OF THE TONE-CORRECTED
C     PERCEIVED NOISE LEVELS PNLT(I); IPTM, THE TIME INDEX COUNTER
C     WHEN PNLT(I)=PNLTM; AND TPNLTM, THE RELATIVE TEST TIME
C     TT(IPTM) WHEN I=IPTM.
C
C        ALSO, FIND ALM, THE MAXIMUM VALUE OF THE A-WEIGHTED SOUND
C        PRESSURE LEVELS AL(I); IAM, THE TIME INDEX COUNTER WHEN
C        AL(I)=ALM; AND TALM, THE RELATIVE TEST TIME TT(IAM) WHEN
C        I=IAM.
C
         PNLM=PNLTM=ALM=-1000.0
         DO 30 I=1,NS
         IF(PNL(I).LE.PNLM)GOTO 26
         PNLM=PNL(I)
         IPM=I
         TPNLM=TT(IPM)
C
   26    IF(PNLT(I).LE.PNLTM)GOTO 27
         PNLTM=PNLT(I)
         IPTM=I
         TPNLTM=TT(IPTM)
C
   27    IF(AL(I).LE.ALM)GOTO 30
         ALM=AL(I)
         IAM=I
         TALM=TT(IAM)
   30    CONTINUE
C
C        LABEL THE 1/3-OCTAVE-BAND SPLS, SPLPTM(J), CORRESPONDING
C     TO THE TIME OF OCCURRENCE OF PNLTM=PNLT(IPTM).
C
         DO 33 J=1,24
   33    SPLPTM(J)=SPL(IPTM,J)
C
```

```
C     LABEL THE 1/3-OCTAVE-BAND SPLS ,SPLAM(J),
C     CORRESPONDING TO THE TIME OF OCCURRENCE
C     OF ALM = AL(IAM).
C
      DO 34 J=1,24
 34   SPLAM(J)=SPL(IAM,J)
C
C     READ NH, THE NUMBER OF HEIGHTS ABOVE GROUND LEVEL WHERE
C  METEOROLOGICAL DATA WERE MEASURED, AND HM(K), THE VALUES
C  OF THE HEIGHTS.
C
      READ (5,35) NH
 35   FORMAT(I3)
      READ (5,36) (HM(K),K=1,NH)
 36   FORMAT(F6.1)
C
C     READ TC(K) AND HR(K), THE AIR TEMPERATURE AND RELATIVE
C     HUMIDITY AT THE TIME OF THE FLYOVER NOISE MEASUREMENT
C     AND AT THE VARIOUS HEIGHTS ABOVE GROUND LEVEL.
C
C     READ BP, THE BAROMETRIC PRESSURE AT THE TIME OF THE
C  FLYOVER NOISE TEST.  THE BAROMETRIC PRESSURE IS USUALLY
C  MEASURED AT A HEIGHT OF 10 M.
C
      READ (5,37) ((TC(K),HR(K)),K=1,NH)
 37   FORMAT(2F5.1)
      READ (5,38) BP
 38   FORMAT(F6.3)
C
C     READ INFORMATION FOR LABELING OUTPUT PAGES.
C
      READ (5,39) TITLE1
 39   FORMAT(20A4)
      READ (5,40) TITLE2
 40   FORMAT(20A4)
      READ (5,41) GROUND
 41   FORMAT(5A4)
C
C**** END OF READING OF INPUT DATA AND OF INITIAL CALCULATIONS.
C
C     CALCULATE THE EFFECTIVE PERCEIVED NOISE LEVEL, EPNL, FROM
C  THE INPUT ARRAY OF PNLT(I) VALUES.  ALSO, FIND INDICES IFP AND
C  ILP FOR THE RELATIVE TIMES AT THE START AND END OF THE SUMMATION
C  OVER THE 10-DB-DOWN TIME OF THE SQUARE OF THE TONE-CORRECTED
C  PERCEIVED NOISINESS.
C
C   INTEGRATION FOLLOWS THE RULE OF SECTION B36.9(E) AND IS
C  JUST BETWEEN THE RELATIVE TIMES OF THE 0.5-SEC DATA SAMPLES
C  THAT ARE CLOSEST TO THE VALUE OF PNLTM-10.0 DB.  INTEGRATION
C  IS PERFORMED BY SUBROUTINE INTEG.
C
      DATA10=PNLTM-10.0
      CALL INTEG(NS,PNLT,DATA10,IFP,ILP,SUMDAT)
      EPNL=10.0*LOG10(SUMDAT)-10.0*LOG10(2.0) -10.0
C
```

```
C     FIND DURATION CORRECTION FACTOR, DCF
C
      DCF=EPNL-PNLTM
C
C     CALCULATE THE SOUND EXPOSURE LEVEL, SEL, FROM THE ARRAY OF
C     INPUT A-WEIGHTED SOUND LEVELS, AL(I).  ALSO FIND THE INDEXES
C     IFA AND ILA FOR THE RELATIVE TIMES AT THE START AND END OF
C     SUMMATION OVER THE 10-DB-DOWN TIME FOR THE SQUARED A-WEIGHTED
C     SOUND PRESSURE.
C
      DATA10=ALM-10.0
      CALL INTEG(NS,AL,DATA10,IFA,ILA,SUMDAT)
      SEL=10.0*LOG10(SUMDAT)-10.0*LOG10(2.0)
C
C     FIND DSEL, DURATION OF SEL
C
      DSEL=SEL-ALM
C
C     DETERMINE TEST-DAY AIR PRESSURE IN STANDARD ATMOSPHERES
C  USING A REFERENCE ATMOSPHERIC PRESSURE OF 29.921 IN. OF HG.
C
      RBPO=29.921
      PA=BP/RBPO
C
C     FOR A UNIFORM REFERENCE ATMOSPHERE, DEFINE REFERENCE AIR
C  TEMPERATURE IN DEGREES CELSIUS AND KELVIN, RELATIVE HUMIDITY
C  IN PERCENT, AND AIR PRESSURE IN STANDARD ATMOSPHERES.
C
      TCR=25.0
      TKR=298.15
      HRR=70.0
      PAR=1.0
C
C     IF APPLICABLE, USE LINEAR INTERPOLATION ON THE VALUES OF
C  AIR TEMPERATURE AND RELATIVE HUMIDITY AT THE FIRST AND SECOND
C  HEIGHTS READ FROM THE INPUT FILE TO OBTAIN CORRESPONDING VALUES
C  AT A HEIGHT OF 10.0 M.  (HM(2) IS ASSUMED TO BE > 10.0 M AND
C  HM(1) IS ASSUMED TO BE < OR = 10.0 M.)
C
      TC10=TC(1)-((TC(1)-TC(2))*((10.0-HM(1))/(HM(2)-HM(1))))
      HR10=HR(1)-((HR(1)-HR(2))*((10.0-HM(1))/(HM(2)-HM(1))))
C
C     FIND THE MOLAR CONCENTRATION OF WATER VAPOR FOR THE
C  TEST-DAY CONDITIONS AT 10 M.
C
      CALL MOLAR(TC10+273.15,HR10,PA,H10)
C
C
C     DEFINE THE REFERENCE HEIGHT, RHM, OF 10.0 M AS THE HEIGHT
C  AT WHICH THE REFERENCE AIR TEMPERATURE, RTKO OF 298.15 DEG K,
C  REFERENCE RELATIVE HUMIDITY, RHRO OF 70.0 PERCENT, AND
C  REFERENCE AIR PRESSURE OF 1.0 STANDARD ATMOSPHERE ARE SPECIFIED.
C     ALSO DEFINE THE REFERENCE LAPSE RATES AS A FUNCTION OF HEIGHT
C  ABOVE THE REFERENCE HEIGHT OF RTKL= -0.0065 DEG K/M,
C  RHRL= -0.0065 PERCENTAGE POINTS/M, AND RPAL= -5.25588 FOR THE
C  EXPONENT OF THE EXPRESSION FOR LAPSE RATE OF THE REFERENCE
C  AIR PRESSURE IN STANDARD ATMOSPHERES.
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```
C
      RHM=10.0
      RTKO=298.15
      RTKL=-0.0065
      RHRO=70.0
      RHRL=-0.0065
      RPAL=-5.25588
C
C     NOW CALCULATE THE VALUE OF THE HEIGHTS AT THE MIDDLE
C     OF EACH HEIGHT INTERVAL (LAYER).
C
C     FOR THE REFERENCE LAPSE RATES, CALCULATE THE CORRESPONDING
C  REFERENCE TEMPERATURES, RELATIVE HUMIDITIES, AND PRESSURES.
C     ALSO CALCULATE THE AVERAGE VALUES OF THE MEASURED AIR
C  TEMPERATURES AND RELATIVE HUMIDITIES AT THE MIDPOINTS OF
C  THE HEIGHT INTERVALS.
C
C     MEASURED TEMPERATURES ARE CONVERTED FROM DEGREES CELSIUS
C     TO KELVINS.
C
C     ALSO CALCULATE THE VERTICAL PROFILES OF HMEA AND HREF FOR THE
C  MOLAR CONCENTRATION OF WATER VAPOR UNDER TEST-DAY AND REFERENCE-
C  DAY LAPSE-RATE CONDITIONS.
C
      DO 42 K=1,NH-1
      HMI(K)=(HM(K+1)+HM(K))/2.
      RTK(K)=RTKO+RTKL*(HMI(K)-RHM)
      RHR(K)=RHRO+RHRL*(HMI(K)-RHM)
      RPA(K)=((RTKO-10.0)/((RTKO-10.0)+(RTKL*HMI(K))))**RPAL
      ATC(K)=(TC(K+1)+TC(K))/2.
      ATK(K)=ATC(K)+273.15
      AHR(K)=(HR(K+1)+HR(K))/2.
      CALL MOLAR(ATK(K),AHR(K),PA,HMEA(K))
 42   CALL MOLAR(RTK(K),RHR(K),RPA(K),HREF(K))
C
C     IF HM(1), THE FIRST HEIGHT AT WHICH METEOROLOGICAL DATA
C  WERE MEASURED, IS > ZM, THEN THE METEOROLOGICAL PARAMETERS
C  CALCULATED ABOVE WILL NOT BE DEFINED OVER THE LAYER OF THE
C  ATMOSPHERE THAT INCLUDES THE MICROPHONE AT HEIGHT ZM.
C     IN THIS CASE, RENUMBER THE INDEX OF THE PARAMETERS
C  (INCREASING IT BY 1) AND DEFINE A NEW SET OF PARAMETERS FOR
C  INDEX 1 EQUAL TO THE PREVIOUS SET FOR OLD INDEX 1 (OR NEW
C  INDEX 2), THEREBY MAKING THE PARAMETERS IDENTICAL FOR THE FIRST
C  TWO LAYERS.
C
      IF(HM(1).GT.ZM)GOTO 43
      GOTO 47
 43   DO 45 L=1,NH
      LL=(NH+2)-L
      HMI(LL)=HMI(LL-1)
      RTK(LL)=RTK(LL-1)
      RHR(LL)=RHR(LL-1)
      RPA(LL)=RPA(LL-1)
      ATC(LL)=ATC(LL-1)
      ATK(LL)=ATK(LL-1)
      AHR(LL)=AHR(LL-1)
      HMEA(LL)=HMEA(LL-1)
 45   HREF(LL)=HREF(LL-1)
```

```
C
C     FOR THE RELATIVE TEST TIMES TT(IPTM) AND TT(IAM)
C     CORRESPONDING TO PNLTM AND ALM, DETERMINE THE TOTAL
C     LENGTHS OF THE SOUND PROPAGATION PATHS, PDPTM AND PDAM,
C     AND THE LENGTHS OF THE VARIOUS SEGMENTS  DPTM(K) AND
C     DAM(K), ALONG THE PATHS THAT CORRESPOND TO THE INTERVALS
C     OF HEIGHT FOR THE METEOROLOGICAL MEASUREMENTS.
C
C     DETERMINE THE TIMES, TRPTM AND TRAM, FOR THE POSITIONS ON
C  THE FLIGHT PATH WHERE THE AIRPLANE WAS WHEN THE SOUND PRESSURE
C  LEVELS SPLPTM(J) AND SPLAM(J), CORRESPONDING TO PNLTM AND ALM,
C  WERE RECEIVED AT THE MICROPHONE.
C
C     TIMES TRPTM AND TRAM ARE CALCULATED RELATIVE TO THE
C  TIME, TOH, WHEN THE AIRPLANE WAS DIRECTLY OVER THE MICROPHONE
C  AND TO THE DATA ANALYSIS START TIME, TS.
C
C     A FACTOR OF 0.25 SECONDS IS INCLUDED TO SHIFT THE
C     RELATIVE TIME SCALE TO THE MIDDLE OF EACH 0.5-S
C     SPL DATA SAMPLE.
C
 47   TRPTM=TS+0.25+TT(IPTM)-TOH
      TRAM=TS+0.25+TT(IAM)-TOH
C
C     FIND THE DISTANCE BETWEEN THE AIRCRAFT AND THE MICROPHONE
C  AT THE TIME THE AIRCRAFT WAS OVERHEAD.
C
      AMH=AH-ZM
C
C     DEFINE PI
C
      PI=3.141592654
C
C     SPECIFY THE FLIGHT PATH ANGLE, GAMAR, IN RADIANS--POSITIVE
C  FOR CLIMBING.
C
      GAMAR=GAMAD*PI/180.0
C
C     CALCULATE DM, THE MINIMUM DISTANCE BETWEEN THE MICROPHONE
C  AND THE FLIGHT PATH; DB, THE DISTANCE ALONG THE FLIGHT PATH
C  FROM THE OVERHEAD POINT TO THE POINT OF CLOSEST APPROACH; AND
C  DISTANCES ALONG THE FLIGHT PATH FROM THE OVERHEAD POINT TO
C  THE AIRCRAFT POSITION AT THE TIME THE SOUND WAS RECEIVED AT
C  THE MICROPHONE, I.E., DISTANCES DOPTM AND DOAM AT RELATIVE
C  TIMES TRPTM AND TRAM, RESPECTIVELY.
      DM=AMH*COS(GAMAR)
      DB=AMH*SIN(GAMAR)
C
C     DETERMINE SOUND PROPAGATION ANGLES, PSI, RELATIVE TO THE
C  FLIGHT PATH AND THE DIRECTION OF FLIGHT, AT THE TIME WHEN THE
C  NOISE WAS EMITTED WHICH WAS LATER RECEIVED AT THE MICROPHONE AT
C  RELATIVE TIMES OF PNLTM AND ALM.
C
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```
      DOPTM=AS*TRPTM
      IF(DB+DOPTM.LT.0.0)PHIPTM=(ATAN(-DM/(DB+DOPTM)))
      IF(DB+DOPTM.EQ.0.0)PHIPTM=PI/2.0
      IF(DB+DOPTM.GT.0.0)PHIPTM=PI-(ATAN(DM/(DB+DOPTM)))
      PSIPTM=PHIPTM-ASIN(AM*SIN(PHIPTM))
C
      DOAM=AS*TRAM
      IF(DB+DOAM.LT.0.0)PHIAM=(ATAN(-DM/(DB+DOAM)))
      IF(DB+DOAM.EQ.0.0)PHIAM=PI/2.0
      IF(DB+DOAM.GT.0.0)PHIAM=PI-(ATAN(DM/(DB+DOAM)))
      PSIAM=PHIAM-ASIN(AM*SIN(PHIAM))
C
C     NOW FIND THE TOTAL LENGTH OF THE PROPAGATION DISTANCE
C     FROM THE SOURCE TO THE RECEIVER AT THE TIMES OF
C     PNLTM AND ALM.
C
      PDPTM=DM/SIN(PSIPTM)
      PDAM=DM/SIN(PSIAM)
C
C     DETERMINE, AHS, THE HEIGHT OF THE AIRPLANE ABOVE THE
C MICROPHONE HEIGHT AT THE TIME THE MAXIMUM NOISE WAS RECEIVED
C AT THE MICROPHONE.
C
      AHSPTM=PDPTM*SIN(PSIPTM-GAMAR)
      AHSAM=PDAM*SIN(PSIAM-GAMAR)
C
C     NOW DETERMINE THE INDICES FROM THE ARRAY OF HEIGHTS FOR
C THE METEOROLOGICAL MEASUREMENTS THAT ARE ONE AND TWO LESS THAN
C THE HEIGHT OF THE AIRCRAFT ABOVE THE MICROPHONE HEIGHT AT THE
C TIMES OF MAXIMUM NOISE.
C
      DO 50 K=1,NH
      IF(HM(K)-ZM.GT.AHSPTM)GOTO 53
   50 CONTINUE
   53 KAP=K-1
      KAP1=KAP-1
C
      DO 55 K=1,NH
      IF(HM(K)-ZM.GT.AHSAM)GOTO 57
   55 CONTINUE
   57 KAA=K-1
      KAA1=KAA-1
C
C     NOW FIND THE LENGTHS OF THE SEGMENTS OF DISTANCE ALONG
C     THE PROPAGATION PATHS CORRESPONDING TO THE INTERVALS OF
C     HEIGHT FOR THE METEOROLOGICAL MEASUREMENTS, DPTM AND DAM.
C
      DO 60 K=1,NH
      IF((HM(K)-ZM).GT.0.0)GOTO 65
   60 CONTINUE
   65 KK=K
C
      DPTM(1)=(HM(KK)-ZM)/SIN(PSIPTM-GAMAR)
      DO 70 K=KK,KAP1
   70 DPTM(K-KK+2)=(HM(K+1)-HM(K))/SIN(PSIPTM-GAMAR)
      DPTM(KAP1-KK+3)=(AHSPTM-(HM(KAP)-ZM))/SIN(PSIPTM-GAMAR)
C
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```
      DAM(1)=(HM(KK)-ZM)/SIN(PSIAM-GAMAR)
      DO 72 K=KK,KAA1
 72   DAM(K-KK+2)=(HM(K+1)-HM(K))/SIN(PSIAM-GAMAR)
      DAM(KAA1-KK+3)=(AHSAM-(HM(KAA)-ZM))/SIN(PSIAM-GAMAR)
C
C      NOW COMPUTE THE 1/3-OCTAVE-BAND ADJUSTMENT FACTORS FOR
C  DIFFERENCES IN ATMOSPHERIC ABSORPTION UNDER TEST AND REFERENCE
C  METEOROLOGICAL CONDITIONS AND APPLY THE ADJUSTMENTS TO THE SPL
C  SPECTRUM AT THE TIME OF PNLTM AND ALM.
C
C      NOTE THAT IF THE TEST-DAY BAND LEVEL IS = 0.0 DB, THEN
C  THE REFERENCE-DAY BAND LEVEL IS ALSO = 0.0 DB.
C
      APMB=APMC=APMD=APME=0.0
C
      DO 85 J=1,24
C
C      FIRST, DETERMINE ATMOSPHERIC ABSORPTION ADJUSTMENT FACTORS
C  USING SAE ARP 866A, MARCH 1975, AND TEST-DAY AIR TEMPERATURE
C  AND RELATIVE HUMIDITY DATA AT A HEIGHT OF 10 M.
C
C      SOUND ABSORPTION COEFFICIENTS FOR REFERENCE-DAY METEOROLOGICAL
C  CONDITIONS ARE CALCULATED DIRECTLY FOR THE SPECIFIED CONDITIONS.
C
      CALL ARP866A(J,TC10,HR10,TALPHA)
      CALL ARP866A(J,TCR,HRR,RALPHA)
      IF(SPLPTM(J).EQ.0.0)GOTO 74
      SPLPTB(J)=SPLPTM(J)+(TALPHA-RALPHA)*PDPTM
      GOTO 75
 74   SPLPTB(J)=0.0
 75   IF(SPLAM(J).EQ.0.0)GOTO 76
      SPLAB(J)=SPLAM(J)+(TALPHA-RALPHA)*PDAM
      GOTO 77
 76   SPLAB(J)=0.0
 77   APMB=APMB+10.0**((SPLAB(J)+AW(J))/10.0)
C
C      SECOND, DETERMINE ATMOSPHERIC ABSORPTION ADJUSTMENT FACTORS
C  USING SAE ARP 866A FOR ATMOSPHERIC ABSORPTION COEFFICIENTS
C  IN DB/M AND AVERAGE AIR TEMPERATURE AND RELATIVE HUMIDITY ALONG
C  SEGMENTS OF THE SOUND PROPAGATION PATH DEFINED BY HORIZONTAL
C  LAYERS OF THE ATMOSPHERE.
C
C      AN AVERAGE SOUND ABSORPTION COEFFICIENT FOR TEST METEOROLOGICAL
C  CONDITIONS IS COMPUTED FROM THE RATIO OF THE TOTAL ATTENUATION OVER
C  THE PROPAGATION PATH TO THE LENGTH OF THE PROPAGATION PATH.
C
C      DEFINE AN INDEX COUNTER FOR THE LAST SEGMENT OF
C  DISTANCES GOING BACK ALONG THE SOUND PROPAGATION PATH
C  FROM THE MICROPHONE TO THE AIRPLANE.
C
      KLP=KAP1-KK+3
      KLA=KAA1-KK+3
C
      ATTPTC=ATTAC=0.0
C
```

```
            DO 80 K=1,KLP
            CALL ARP866A(J,ATC(K),AHR(K),TALPHA)
  80        ATTPTC=ATTPTC+(TALPHA*DPTM(K))
C
            DO 81 K=1,KLA
            CALL ARP866A(J,ATC(K),AHR(K),TALPHA)
  81        ATTAC=ATTAC+(TALPHA*DAM(K))
C
        AVALFPTC=ATTPTC/PDPTM
        AVALFAC=ATTAC/PDAM
        IF(SPLPTM(J).EQ.0.0)GOTO 82
        SPLPTC(J)=SPLPTM(J)+(AVALFPTC-RALPHA)*PDPTM
        GOTO 83
  82    SPLPTC(J)=0.0
  83    IF(SPLAM(J).EQ.0.0)GOTO 84
        SPLAC(J)=SPLAM(J)+(AVALFAC-RALPHA)*PDAM
        GOTO 85
  84    SPLAC(J)=0.0
  85    APMC=APMC+10.0**((SPLAC(J)+AW(J))/10.0)
C
C           THIRD, DETERMINE ATMOSPHERIC-ABSORPTION BAND-ADJUSTMENT
C       FACTORS USING ANS S1.26-1978 FOR PURE-TONE ATMOSPHERIC
C       ABSORPTION COEFFICIENTS AND COMPUTE THE ADJUSTMENT FACTORS
C       BY INTEGRATING OVER THE BANDWIDTH OF THE 1/3-OCTAVE-BAND
C       FILTERS ASSUMING EACH FILTER'S TRANSMISSION RESPONSE IS THAT
C       OF AN IDEAL FILTER WITH THE SAME GEOMETRIC MEAN FREQUENCY.
C
C           COMPUTE THE TOTAL DIFFERENCE IN ATTENUATION UNDER TEST
C       AND REFERENCE METEOROLOGICAL CONDITIONS AS THE SUM OF THE
C       DIFFERENCES IN ATTENUATION OVER SEGMENTS OF THE SOUND
C       PROPAGATION PATH.  THE SEGMENTS ARE DEFINED BY HORIZONTAL
C       LAYERS OF THE ATMOSPHERE OVER WHICH THE AIR TEMPERATURE
C       AND RELATIVE HUMIDITY ARE ASSUMED TO HAVE THE AVERAGE
C       VALUES GIVEN AT THE HEIGHTS OF THE MIDPOINTS OF EACH LAYER.
C
C           CALL SUBROUTINE NUMINT TO GET THE BAND ADJUSTMENT FACTORS,
C       BA, FROM TEST TO REFERENCE METEOROLOGICAL CONDITIONS ALONG
C       THE SOUND PROPAGATION PATH FOR EACH 1/3-OCTAVE BAND.
C
        CALL NUMINT(SPLPTM,TKR,HRR,PAR,ATK,AHR,PA,DPTM,KLP,BAPTD)
C
        CALL NUMINT(SPLAM,TKR,HRR,PAR,ATK,AHR,PA,DAM,KLA,BAAD)
C
C           CALCULATE SPLS ADJUSTED TO REFERENCE CONDITIONS
C
        DO 93 J=1,24
C
        IF(SPLPTM(J).EQ.0.0)GOTO 90
        SPLPTD(J)=SPLPTM(J)+BAPTD(J)
        GOTO 91
  90    SPLPTD(J)=0.0
  91    IF(SPLAM(J).EQ.0.0)GOTO 92
        SPLAD(J)=SPLAM(J)+BAAD(J)
        GOTO 93
  92    SPLAD(J)=0.0
  93    APMD=APMD+10.0**((SPLAD(J)+AW(J))/10.0)
C
```

```
C         FOURTH, DETERMINE ATMOSPHERIC-ABSORPTION BAND-ADJUSTMENT
C     FACTORS, BAPTE AND BAAE, USING ANS S1.26-1978 FOR PURE-TONE
C     ATMOSPHERIC ABSORPTION COEFFICIENTS.
C
C         APPROXIMATE THE ATTENUATION OVER THE FREQUENCY RANGE OF
C     EACH 1/3-OCTAVE-BAND FILTER BY THE ATTENUATION AT THE
C     GEOMETRIC MEAN FREQUENCY ONLY.  COMPUTE THE APPROXIMATE
C     DIFFERENCE IN TOTAL ATTENUATION UNDER TEST AND REFERENCE
C     METEOROLOGICAL CONDITIONS AS THE SUM OF THE DIFFERENCES IN
C     ATTENUATION OF THE GEOMETRIC MEAN FREQUENCY OVER SEGMENTS
C     OF THE SOUND PROPAGATION PATH DEFINED BY HORIZONTAL LAYERS
C     OF THE ATMOSPHERE OVER WHICH THE AIR TEMPERATURE AND
C     RELATIVE HUMIDITY ARE ASSUMED TO HAVE THE AVERAGE VALUES
C     GIVEN AT THE HEIGHTS OF THE MIDPOINTS OF EACH LAYER.
C
          DO 100 J=1,24
C
          ISBN=16+J
          FC=10.0**(ISBN/10.0)
          CALL ANSAB(TKR,HRR,PAR,FC,AR)
C
          BAPTE=BAAE=0.0
             DO 95 K=1,KLP
             CALL ANSAB(ATK(K),AHR(K),PA,FC,ATE)
     95      BAPTE=BAPTE+(ATE-AR)*DPTM(K)
C
             DO 96 K=1,KLA
             CALL ANSAB(ATK(K),AHR(K),PA,FC,ATE)
     96      BAAE=BAAE+(ATE-AR)*DAM(K)
C
          IF(SPLPTM(J).EQ.0.0)GOTO 97
          SPLPTE(J)=SPLPTM(J)+BAPTE
          GOTO 98
     97   SPLPTE(J)=0.0
     98   IF(SPLAM(J).EQ.0.0)GOTO 99
          SPLAE(J)=SPLAM(J)+BAAE
          GOTO 100
     99   SPLAE(J)=0.0
    100   APME=APME+10.0**((SPLAE(J)+AW(J))/10.0)
C
C         CALCULATE CORRESPONDING PNL, PNLT, AND EPNL
C
          CALL CPNL(SPLPTB,PNLMB)
          CALL P36TC(SPLPTB,CMXB,JMXB)
          FMXB=(FLOAT(FREQ(JMXB)))/1000.0
          PNLTMB=PNLMB+CMXB
          EPNLB=PNLTMB+DCF
C
          CALL CPNL(SPLPTC,PNLMC)
          CALL P36TC(SPLPTC,CMXC,JMXC)
          FMXC=(FLOAT(FREQ(JMXC)))/1000.0
          PNLTMC=PNLMC+CMXC
          EPNLC=PNLTMC+DCF
C
```

```
      CALL CPNL(SPLPTD,PNLMD)
      CALL P36TC(SPLPTD,CMXD,JMXD)
      FMXD=(FLOAT(FREQ(JMXD)))/1000.0
      PNLTMD=PNLMD+CMXD
      EPNLD=PNLTMD+DCF
C
      CALL CPNL(SPLPTE,PNLME)
      CALL P36TC(SPLPTE,CMXE,JMXE)
      FMXE=(FLOAT(FREQ(JMXE)))/1000.0
      PNLTME=PNLME+CMXE
      EPNLE=PNLTME+DCF
C
C     CALCULATE CORRESPONDING AL AND SEL
C
      ALMB=10.0*LOG10(APMB)
      SELB=ALMB+DSEL
C
      ALMC=10.0*LOG10(APMC)
      SELC=ALMC+DSEL
C
      ALMD=10.0*LOG10(APMD)
      SELD=ALMD+DSEL
C
      ALME=10.0*LOG10(APME)
      SELE=ALME+DSEL
C
C*******   END OF CALCULATIONS    ************************
C
C     SET PAGE COUNTERS AND INITIAL VALUES OF TIME INDEX COUNTERS
C
      LPGTOT=INT((FLOAT(NS)/14.0)+0.99)
      IS=1
      IE=14
      LPAGE=0
      IF(NS.GT.150) STOP 'NS EXCEEDS 150'
C
C     LIST THE TEST-DAY SPL DATA AND THE TEST-DAY NOISE MEASURES
C
  990 LPAGE=LPAGE+1
      WRITE (6,995) RUN,MIC,LPAGE,LPGTOT
  995 FORMAT('1',/,T14,'RUN NO.: ',I3,'; MIC NO.: ',I1,
     1T80,'DATA PAGE ',I2,' OF ',I2)
      WRITE (6,1000) TITLE1
 1000 FORMAT(/,T1,'|',T20,20A4,T111,'|')
      WRITE (6,1010) TITLE2
 1010 FORMAT(T20,20A4)
      WRITE (6,1020) DATE,MONTH,YEAR,ZM,TS
 1020 FORMAT(/,T27,'TEST DATE: ',I2,1A4,' ',I2,'; '
     1'MIC HT: ',F3.1,' M; START TIME: ',F7.1,' S')
      WRITE (6,1030) TOH,AH,AS,GROUND
 1030 FORMAT(T17,'TIME OH: ',F7.1,' S; HT OH: ',F6.1,' M; '
     1'AIRSPEED OH: ',F4.1,' M/S; GRND SURF: ',5A4)
      WRITE (6,1040)
 1040 FORMAT(/,T12,'CENTER',12X,'1/3-OCTAVE-BAND SOUND PRESSURE '
     1'LEVEL, DB RE 20 MICROPASCALS')
      WRITE (6,1050)
 1050 FORMAT(T12,'FREQ.,',27X,'TIME RELATIVE TO START TIME, S')
      WRITE (6,1060) (TT(I),I=IS,IE)
 1060 FORMAT(T14,'HZ',2X,14F6.1)
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      DO 1090 J=1,24
      NJ=J-1
      IF(NJ.EQ.0)GOTO 1070
      IF(MOD(NJ,3).EQ.0)GOTO 1070
      GOTO 1080
 1070 WRITE (6,1075) (FREQ(J),(SPL(I,J),I=IS,IE))
 1075 FORMAT(/,T13,I5,14F6.1)
      GOTO 1090
 1080 WRITE (6,1085) (FREQ(J),(SPL(I,J),I=IS,IE))
 1085 FORMAT(T13,I5,14F6.1)
 1090 CONTINUE
      WRITE (6,1100) (PNL(I),I=IS,IE)
 1100 FORMAT(/,T12,'PNL,DB',14F6.1)
      WRITE (6,1110) (PNLT(I),I=IS,IE)
 1110 FORMAT(T11,'PNLT,DB',14F6.1)
      WRITE (6,1120) (AL(I),I=IS,IE)
 1120 FORMAT(T1,'|',T13,'AL,DB',14F6.1,T111,'|')
      WRITE(6,1122) (FMX(I),I=IS,IE)
 1122 FORMAT(T11,'FMX,KHZ',14F6.3)
      WRITE(6,1124)
 1124 FORMAT(T18,'FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE '
     1'1/3-OCTAVE BAND THAT PRODUCES C(I)')
      WRITE(6,1126)
 1126 FORMAT(T12,'C(I) IS THE LARGEST OF THE TONE-CORRECTION '
     1'FACTORS FOR THE CORRESPONDING '
     2'SPECTRUM SPL(I,J)')
      IF(IE.NE.NS)GOTO 1150
      WRITE (6,1130) PNLM,TPNLM,PNLTM,TPNLTM,DCF,TT(IFP),TT(ILP)
 1130 FORMAT(/,T11,'PNLM= ',F5.1,' DB AT ',F4.1,' S; PNLTM= ',
     1F5.1,' DB AT ',F4.1,' S; DCF= ',F4.1,' DB FROM ',F4.1,
     2' TO ',F4.1,' S')
      WRITE (6,1140) EPNL
 1140 FORMAT(T1,'|',T11,'EPNL=PNLTM+DCF= ',F5.1,' DB',T111,'|')
      WRITE (6,1145) ALM,TALM,SEL,TT(IFA),TT(ILA)
 1145 FORMAT(T11,'ALM= ',F5.1,' DB AT ',F4.1,' S; SEL= ',F5.1,
     1' DB; TSEL FROM  ',F4.1,' TO  ',F4.1,' S')
C
C     REITERATE FOR NEXT PAGE UNTIL GET TO LAST PAGE FOR INPUT DATA
C
      IF(IE.EQ.NS)GOTO 1800
 1150 IS=MIN0(IE+1,NS)
      IE=MIN0(IE+14,NS)
      IF(IE.LE.NS)GOTO 990
C
C     TABULATE THE RESULTS OF APPLYING VARIOUS METHODS FOR ADJUSTING
C     SOUND PRESSURE LEVELS FOR DIFFERENCES IN ATMOSPHERIC ABSORPTION
C     UNDER TEST AND REFERENCE METEOROLOGICAL CONDITIONS
C
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C       SUMMARY OUTPUT PAGE 1 FOR METEOROLOGICAL DATA
C
 1800   WRITE (6,1810) RUN,MIC
 1810   FORMAT('1',5/,T1,'|',T17,'RUN NO.: ',I3,'; MIC NO.: ',I1,
       1T48,'METEOROLOGICAL DATA',T76,'PAGE 1 OF SUMMARY',18X,'|')
        WRITE (6,1820)
 1820   FORMAT(//,T16,'HEIGHT AT   MEAS. TEMP.  MEAS. R.H.   MEAS.'
       1' MOLAR   REF. TEMP.    REF. R.H.  REF. MOLAR')
        WRITE (6,1830)
 1830   FORMAT(T15,'MIDPOINT OF  OVER HEIGHT  OVER HEIGHT   CONC.'
       1' OF      AT MID. OF   AT MID. OF   CONC. OF')
        WRITE (6,1840)
 1840   FORMAT(T16,'INTERVAL,    INTERVAL,    INTERVAL,  WATER '
       1'VAPOR,   INTERVAL,    INTERVAL,  WATER VAPOR,')
        WRITE (6,1850)
 1850   FORMAT(T20,'M            C           PCT.       PCT.'
       1'           C           PCT.         PCT.')
        WRITE (6,1855)
 1855   FORMAT (/)
        IF(HM(1).GT.ZM)GOTO 1857
        GOTO 1858
 1857   WRITE(6,1860)((HMI(K),ATK(K)-273.15,AHR(K),HMEA(K),
       1RTK(K)-273.15,RHR(K),HREF(K)),K=1,NH)
        GOTO 1860
 1858   WRITE(6,1860)((HMI(K),ATK(K)-273.15,AHR(K),HMEA(K),
       1RTK(K)-273.15,RHR(K),HREF(K)),K=1,NH-1)
 1860   FORMAT(T17,F6.1,9X,F4.1,9X,F4.1,8X,F5.3,9X,F4.1,9X,F4.1,8X,F5.3)
        WRITE (6,1870) PA*101.325,PA
 1870   FORMAT  (/,T24,'STATION BAROMETRIC PRESSURE = ',F7.3,
       1' KPA ( ',F5.3,' STD. ATM.)')
        WRITE (6,1880) TC10,HR10,H10
 1880   FORMAT(/,T1,'|',T12,'AT 10 M: MEAS. AIR TEMP.= ',F4.1,
       1' DEG C; MEAS. REL. HUM.= ',F4.1,' PCT; MEAS. MOLAR CONC.'
       2'= ',F5.3,' PCT',T111,'|')
        WRITE (6,1890)
 1890   FORMAT(T23,'REF.AIR TEMP.= 25.0 DEG C;  REF. REL. HUM.'
       1'= 70.0 PCT;  REF. MOLAR CONC.= 2.18774 PCT')
C
C       SUMMARY OUTPUT PAGES 2 AND 3 FOR NOISE DATA
C
        DO 2300 NPG=1,2
        IF(NPG.EQ.1)WRITE(6,2000)RUN,MIC
        IF(NPG.EQ.2)WRITE(6,2010)RUN,MIC
 2000   FORMAT('1',2/,T1,'|',T14,'RUN NO.: ',I3,'; MIC NO.: ',I1,
       1T51,'PNL AND EPNL',T76,'PAGE 2 OF SUMMARY',18X,'|')
 2010   FORMAT('1',3/,T1,'|',T14,'RUN NO.: ',I3,'; MIC NO.: ',I1,
       1T52,'AL AND SEL',T76,'PAGE 3 OF SUMMARY',18X,'|')
        WRITE (6,2020)
 2020   FORMAT(/,T21,'TEST-DAY NOISE DATA ADJUSTED TO '
       1'ACOUSTICAL REFERENCE-DAY CONDITIONS')
        WRITE (6,2030) TITLE2
 2030   FORMAT(T20,20A4)
        WRITE (6,2040)
 2040   FORMAT(T19,'REF.-DAY COND.: AIR TEMP = 25.0 C; REL HUM = '
       1'70.0 PCT; PRESS = 1.0 STD ATM')
```

```
      WRITE (6,2050)
 2050 FORMAT(/,T13,'BAND',3X,'(A)',4X,'(B)',4X,'(C)',4X,'(D)',
     14X,'(E)')
      WRITE (6,2060)
 2060 FORMAT(T12,'CENTER',2X,'TEST',3X,'ADJ.',3X,'ADJ.',3X,'ADJ.',
     13X,'ADJ')
      WRITE (6,2070)
 2070 FORMAT(T12,'FREQ.,',2X,'SPL,',3X,'SPL,',3X,'SPL,',3X,'SPL,',
     13X,'SPL,')
      WRITE (6,2080)
 2080 FORMAT(T14,'HZ',5X,'DB',5X,'DB',5X,'DB',5X,'DB',5X,'DB',/)
      JJ=0
      DO 2160 J=1,24
      JJ=JJ+1
C
C     PRINT OUTPUT DATA AND A LINE OF TEXT
C
      IF(NPG.EQ.1)GOTO 2110
      IF(J.EQ.3.AND.NPG.EQ.2)GOTO 2130
      IF(NPG.EQ.2)GOTO 2120
 2100 FORMAT(T13,I5,F6.1,4F7.1,T58,12A4)
 2110 WRITE (6,2100) (FREQ(J),SPLPTM(J),SPLPTB(J),SPLPTC(J),
     1SPLPTD(J),SPLPTE(J)),(TEXT(II,JJ),II=1,12)
      GOTO 2140
 2120 WRITE(6,2100)(FREQ(J),SPLAM(J),SPLAB(J),SPLAC(J),
     1SPLAD(J),SPLAE(J)),(TEXT(II,JJ),II=1,12)
      GOTO 2140
 2130 WRITE(6,2100)(FREQ(J),SPLAM(J),SPLAB(J),SPLAC(J),
     1SPLAD(J),SPLAE(J)),(TEXTA(II),II=1,12)
 2140 IF(MOD(J,3).NE.0)GOTO 2160
      IF(J.EQ.24)GOTO 2170
C
C     PRINT A LINE OF TEXT ONLY
C
      JJ=JJ+1
      WRITE (6,2150) (TEXT(II,JJ),II=1,12)
 2150 FORMAT(T58,12A4)
 2160 CONTINUE
 2170 IF(NPG.EQ.1)GOTO 2180
      IF(NPG.EQ.2)GOTO 2240
C
C     BOTTOM OF PAGE 2
C
 2180 WRITE (6,2190) (PNLM,PNLMB,PNLMC,PNLMD,PNLME)
 2190 FORMAT(//,T12,'PNL,DB',F6.1,4F7.1)
      WRITE (6,2200) (PNLTM,PNLTMB,PNLTMC,PNLTMD,PNLTME)
 2200 FORMAT(T11,'PNLT,DB',F6.1,4F7.1)
      WRITE (6,2210) (EPNL,EPNLB,EPNLC,EPNLD,EPNLE)
 2210 FORMAT(T11,'EPNL,DB',F6.1,4F7.1)
      WRITE (6,2215) (FMXB,FMXC,FMXD,FMXE)
 2215 FORMAT(T11,'FMX,KHZ',T24,4F7.3)
      WRITE (6,2220) AMH
 2220 FORMAT(//,T21,'AIRPLANE HEIGHT OVER MICROPHONE '
     1'= ',F6.1,' M')
      WRITE (6,2230) PDPTM
 2230 FORMAT(T1,'|',T21,'SOUND PROPAGATION PATHLENGTH'
     1' FOR TEST SPLS AT PNLTM = ',F6.1,' M',T111,'|')
      WRITE (6,2235) (PSIPTM*57.29577951)
 2235 FORMAT(T21,'SOUND PROPAGATION ANGLE RELATIVE TO'
     1' DIRECTION OF FLIGHT = ',F5.1,' DEG AT PNLTM')
```

```
      GOTO 2300
C
C     BOTTOM OF PAGE 3
C
2240  WRITE(6,2250)(ALM,ALMB,ALMC,ALMD,ALME)
2250  FORMAT(//,T13,'AL,DB',F6.1,4F7.1)
      WRITE(6,2260)(SEL,SELB,SELC,SELD,SELE)
2260  FORMAT(T12,'SEL,DB',F6.1,4F7.1)
      WRITE(6,2270) AMH
2270  FORMAT(//,T21,'AIRPLANE HEIGHT OVER MICROPHONE '
     1'= ',F6.1,' M')
      WRITE(6,2280) PDAM
2280  FORMAT(T1,'|',T21,'SOUND PROPAGATION PATHLENGTH'
     1' FOR TEST SPLS AT ALM = ',F6.1,' M',T111,'|')
      WRITE (6,2290) (PSIAM*57.29577951)
2290  FORMAT(T21,'SOUND PROPAGATION ANGLE RELATIVE'
     1' TO DIRECTION OF FLIGHT = ',F5.1,' DEG AT ALM')
2300  CONTINUE
C
C     READ NEXT SET OF INPUT DATA.  STOP IF RUN NO. = 999.
C
      READ (5,10) RUN
      IF(RUN.NE.999)GOTO 11
      STOP 'END OF INPUT DATA'
      END
C
C     END OF STATEMENTS FOR MAIN PROGRAM.
```

BLOCK DATA

The labeled common statements in BLOCK DATA contain, in 384 computer words, the text for 31 lines on output summary pages 2 and 3. Some of the lines of text are blank. The words of the text describe the legends for the columns labeled (A), (B), (C), (D), and (E) of measured test-day and reference-day 1/3-octave-band sound pressure levels.

```
C
C******************************************************************
C
C***  LISTING OF BLOCK DATA FOR CODES ON OUTPUT SUMMARY PAGES
C
      BLOCK DATA
C
      COMMON /CTEXT/ TEXT1(12),TEXT2(12),TEXT3(12),TEXT4(12),
     1TEXT5(12),TEXT6(12),TEXT7(12),TEXT8(12),TEXT9(12),TEXT10(12),
     2TEXT11(12),TEXT12(12),TEXT13(12),TEXT14(12),TEXT15(12),
     3TEXT16(12),TEXT17(12),TEXT18(12),TEXT19(12),TEXT20(12),
     4TEXT21(12),TEXT22(12),TEXT23(12),TEXT24(12),TEXT25(12),
     5TEXT26(12),TEXT27(12),TEXT28(12),TEXT29(12),TEXT30(12),
     6TEXT31(12),TEXTA(12)
C
      DIMENSION TEXT(12,31)
C
      EQUIVALENCE (TEXT(1,1),TEXT1(1))
C
      DATA TEXT/372(4H    )/
      DATA TEXT1/'                COLUMN CODES:                   '/
      DATA TEXT3/'(A)TEST-DAY SPLS AT TIME OF TEST-DAY PNLTM +    '/
      DATA TEXT4/'   ASSOCIATED INTEGRATED NOISE MEASURES.        '/
      DATA TEXT6/'THEN, TEST-DAY SPLS ADJUSTED TO ACOUSTICAL      '/
      DATA TEXT7/'REFERENCE-DAY CONDITIONS + ASSOCIATED           '/
      DATA TEXT8/'MEASURES.  ADJUSTMENTS MADE USING:              '/
      DATA TEXT10/' (B)10-M MET. DATA AND SAE ARP 866A;            '/
      DATA TEXT11/' (C)LAYERED MET. DATA ALOFT AND SAE ARP 866A;   '/
      DATA TEXT12/' (D)LAYERED MET. DATA ALOFT AND ABSORPTION BY   '/
      DATA TEXT13/'    ANS S1.26-1978 INTEGRATED OVER PASSBAND;    '/
      DATA TEXT14/' (E)LAYERED MET. DATA ALOFT AND ABSORPTION BY   '/
      DATA TEXT15/'    ANS S1.26-1978 AT BAND CENT. FREQ. ONLY.    '/
C
      DATA TEXTA/'(A)TEST-DAY SPLS AT TIME OF TEST-DAY ALM +      '/
C
      END
```

SUBROUTINE CPNL(SPL, PNL)

Subroutine CPNL accepts an array of 24 1/3-octave-band sound pressure levels and calculates the corresponding perceived noise level, PNL. It requires about 355 computer words or approximately 1400 bytes of storage capacity.

```
C
      SUBROUTINE CPNL(SPL,PNL)
C
C**********************************************************************
C
C   SPL IS INPUT ARRAY OF 1/3-OCTAVE-BAND SPLS FROM 50 TO 10,000 HZ
C        FOR WHICH PNL IS TO BE DETERMINED; DB.
C
C     PERCEIVED NOISINESS, PN, IN NOYS IS CALCULATED FOR THE
C  CORRESPONDING 1/3-OCTAVE-BAND SOUND PRESSURE LEVEL, SPL, AND
C  BAND INDEX COUNTER, J, WHERE J RANGES FROM 1 TO 24 FOR THE
C  NOMINAL BAND CENTER FREQUENCIES FROM 50 TO 10,000 HZ.
C
C     THE BAND PERCEIVED NOISINESS IS SET EQUAL TO 0.0 NOYS FOR ANY
C     BAND SPL LESS THAN THE CORRESPONDING CONSTANTS L1 IN THE
C     DATA LIST.
C
C     IF ALL SPL(J) ARE < L1(J), THEN THE PNL IS SET = 0.0 DB.
C
C     THE COMPUTATION ASSUMES THAT NO BAND SOUND PRESSURE LEVEL
C     IS GREATER THAN 150.0 DB.
C
C     DATA CONSTANTS ARE FROM SAE ARP 865A, 15 AUGUST 1969.
C
C   PNL IS THE PERCEIVED NOISE LEVEL CORRESPONDING TO THE ARRAY
C        OF SPLS; DB.
C
C**********************************************************************
C
      REAL   L1,M1,L2,M2,L3,M3,LC,L4,M4
      DIMENSION L1(24),M1(24),L2(24),M2(24),L3(24),M3(24),
     1LC(24),L4(24),M4(24),SPL(24)
C
      DATA L1/49.,44.,39.,34.,30.,27.,24.,21.,18.,16.,16.,16.,16.,
     116.,15.,12.,9.,5.,4.,5.,6.,10.,17.,21./
      DATA M1/.079520,.068160,.068160,.059640,.053013,.053013,
     1.053013,.053013,.053013,.053013,.053013,.053013,.053013,
     2.053013,.059640,.053013,.053013,.047712,.047712,.053013,
     3.053013,.068160,.079520,.059640/
      DATA L2/55.,51.,46.,42.,39.,36.,33.,30.,27.,25.,25..25.,25.,
     125.,23.,21.,18.,15.,14.,14.,15.,17.,23.,29./
      DATA M2/.058098,.058098,.052288,.047534,.043573,.043573,
     1.040221,.037349,.034859,.034859,.034859,.034859,.034859,
     2.034859,.034859,.040221,.037349,.034859,.034859,.034859,
     3.034859,.037349,.037349,.043573/
      DATA L3/64.,60.,56.,53.,51.,48.,46.,44.,42.,40.,40.,40.,40.,
     140.,38.,34.,32.,30.,29.,29.,30.,31.,37.,41./
      DATA M3/.043478,.040570,.036831,.036831,.035336,.033333,
     1.033333,.032051,.030675,.030103,.030103,.030103,.030103,
     2.030103,.030103,.029960,.029960,.029960,.029960,.029960,
     3.029960,.029960,.042285,.042285/
      DATA LC/91.01,85.88,87.32,79.85,79.76,75.96,73.96,74.91,94.63,
     1100.,100.,100.,100.,100.,100.,100.,100.,100.,100.,100.,100.,
     2100.,44.29,50.72/
```

```
      DATA M4/.030103,.030103,.030103,.030103,.030103,.030103,
     1.030103,.030103,.030103,.030103,.030103,.030103,.030103,
     2.030103,.030103,.029960,.029960,.029960,.029960,.029960,
     3.029960,.029960,.029960,.029960/
      DATA L4/52.,51.,49.,47.,46.,45.,43.,42.,41.,40.,40.,40.,
     140.,40.,38.,34.,32.,30.,29.,29.,30.,31.,34.,37./
C
      PNSUM=0.0; PNMX=-10.0
      DO 80 J=1,24
      IF(SPL(J).LT.L1(J))GOTO 5
      GOTO 7
    5 PN=0.0
      GOTO 75
    7 IF(SPL(J).GE.L1(J).AND.SPL(J).LT.L2(J))  GOTO 10
      GOTO 20
   10 PN=0.1*(10.**((M1(J))*(SPL(J)-L1(J))))
      GOTO 75
   20 IF(SPL(J).GE.L2(J).AND.SPL(J).LT.L3(J)) GOTO 30
      GOTO 40
   30 PN=10.**((M2(J))*(SPL(J)-L3(J)))
      GOTO 75
   40 IF(SPL(J).GE.L3(J).AND.SPL(J).LT.LC(J)) GOTO 50
      GOTO 60
   50 PN=10.**((M3(J))*(SPL(J)-L3(J)))
      GOTO 75
   60 IF(SPL(J).GE.LC(J).AND.SPL(J).LE.150.) GOTO 70
   70 PN=10.**((M4(J))*(SPL(J)-L4(J)))
   75 PNMX=AMAX(PNMX,PN)
      PNSUM=PNSUM + PN
   80 CONTINUE
      PNT=0.85*PNMX + 0.15*PNSUM
      IF(PNT)90,90,85
   85 PNL=40.0 + 33.22*LOG10(PNT)
      RETURN
   90 PNL=0.0
      RETURN
      END
```

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SUBROUTINE P36TC(SPL, CMX, JMX)

Subroutine P36TC accepts an array of 24 1/3-octave-band sound pressure levels and calculates a tone-correction penalty, CMX, appropriate for that spectrum using a procedure consistent with the requirements of the April 1978 version of Part 36 of the Federal Aviation Regulations. The index counter, JMX, for the 1/3-octave-band producing the largest tone correction factor is also found and returned. If certain requirements are not satisfied, no tone-correction factor is calculated (CMX = 0.0 dB) and a value of JMX = 1 is returned to indicate the impossible, by definition, result of a tone in the band at 50 Hz as a warning that no tone correction was calculated.

P36TC requires about 400 words or about 1650 bytes of storage for the source code.

```
C
      SUBROUTINE P36TC(SPL,CMX,JMX)
C
C**********************************************************************
C
C   SPL  IS THE INPUT ARRAY OF 24 SPL VALUES FOR 1/3-OCTAVE BANDS
C        FROM 50 TO 10,000 HZ AT THE I-TH INSTANT OF TIME DURING
C        A FLYOVER; DB.
C
C   CMX  IS THE LARGEST VALUE OF THE TONE-CORRECTION FACTORS
C        CALCULATED BY SUBROUTINE P36TC; DB
C
C   JMX  IS THE FREQUENCY BAND INDEX COUNTER FOR THE 1/3-OCTAVE
C        BAND PRODUCING THE VALUE OF C IDENTIFIED AS CMX BY THE
C        SUBROUTINE.
C
C**********************************************************************
C
C     SUBROUTINE P36TC(SPL,CMX,JMX) EXAMINES A SET OF 1/3-OCTAVE-
C BAND SOUND PRESSURE LEVELS AND DETERMINES A TONE-CORRECTION
C PENALTY WHICH IS TO BE ADDED TO THE PERCEIVED NOISE LEVEL FOR THE
C SPL SPECTRUM TO GIVE THE TONE-CORRECTED PNL, OR PNLT.
C
C     TONE-CORRECTION FACTORS FOR THE PRESENCE OF PRONOUNCED
C IRREGULARITIES IN THE SPL SPECTRUM ARE CALCULATED BY THE
C PROCEDURE GIVEN IN SECTION B36.5 OF APPENDIX B TO FAR PART 36,
C CHANGE 8, EFFECTIVE 3 APRIL 1978, WITH INTERPRETATIONS DESCRIBED
C BELOW.
C
C     THE REQUIREMENT OF A36.5(D)(3) OF CHANGE 8 OF PART 36 THAT NO
C  EPNL BE CALCULATED OR REPORTED IF ANY SPECTRUM WITHIN THE
C  10-DB-DOWN DURATION HAS MORE THAN FOUR MISSING BAND LEVELS OUT
C  OF 24 IN THE RANGE OF BAND CENTER FREQUENCIES FROM 50 TO 10,000 HZ
C  IS SPECIFICALLY NOT INCORPORATED HERE BECAUSE TO HAVE DONE SO WOULD
C  HAVE ELIMINATED THE PNLT AND EPNL CALCULATIONS FOR SOME OF
C  THE AIRCRAFT NOISE MEASUREMENTS AVAILABLE FOR THE STUDY OF
C  ATMOSPHERIC ABSORPTION ADJUSTMENTS FOR AIRCRAFT NOISE DATA.
C
C     PARAGRAPH B36.5(M) OF PART 36, CHANGE 8, PERMITS THE EXCLUSION
C  OF TONE-CORRECTION PENALTIES RESULTING FROM SPECTRAL IRREGULARITIES
C  (OR PSEUDOTONES) CAUSED BY GROUND-REFLECTION EFFECTS IN THE FREQUENCY
C  RANGE COVERED BY THE 1/3-OCTAVE BANDS WITH CENTER FREQUENCIES OF
C  800 HZ AND LOWER (I.E., BAND NO. 13 AND LOWER).
C
C     SINCE MOST AVAILABLE AIRCRAFT FLYOVER NOISE DATA WERE MEASURED
C  BY MICROPHONES LOCATED 1.2 M ABOVE THE GROUND PLANE, MOST OF
C  THE MEASURED SOUND PRESSURE LEVELS WERE KNOWN TO CONTAIN LOW-
C  FREQUENCY SPECTRAL IRREGULARITIES CAUSED BY GROUND-REFLECTION
C  EFFECTS.
C
C     BECAUSE THERE WAS NO CONVENIENT WAY TO ELIMINATE THE
C  SPECTRAL IRREGULARITIES CAUSED BY GROUND REFLECTION EFFECTS
C  AND BECAUSE IT WAS NECESSARY TO HAVE A CONSISTENT DETERMINATION
C  OF THE EFFECTS OF DIFFERENT METHODS OF ACCOUNTING FOR
C  ATMOSPHERIC ABSORPTION ON TONE-CORRECTED PNLS AND EPNLS,
C  SUBROUTINE P36TC INCORPORATES THE OPTION OF B36.5(M) AND
C  CALCULATES TONE CORRECTIONS ONLY OVER THE RANGE OF BAND
C  CENTER FREQUENCIES FROM 1000 HZ (BAND 14) TO 10,000 HZ
C  (BAND 24).
C
C      THE AIRCRAFT NOISE SPECTRA WHICH ARE BEING EXAMINED ARE KNOWN
C TO HAVE BAND LEVELS WHICH HAVE BEEN SET ARBITRARILY TO 0.0 DB
C BECAUSE THE SPL SIGNAL FROM THE AIRCRAFT IN THAT BAND AT SOME
C PARTICULAR INSTANT OF TIME WAS NOT MORE THAN 5 DB GREATER THAN
C THE CORRESPONDING AMBIENT NOISE LEVEL IN THAT BAND.  STRAIGHT-
C FORWARD APPLICATION OF THE FAR PART 36 TONE-CORRECTION PROCEDURE
C WOULD INDICATE THAT SPECTRA WITH MISSING BAND LEVELS WOULD HAVE
C PRONOUNCED SPECTRAL IRREGULARITIES, EVEN THOUGH IT WAS NOT BECAUSE
C OF A PURE-TONE NOISE SOURCE ON THE AIRCRAFT.
C
C      A PROCEDURE, ADOPTED FROM THE USAF OMEGA 5.5 COMPUTER
C  PROGRAM FOR ANALYZING AIRCRAFT FLYOVER NOISE MEASUREMENTS,
C  IS USED TO AVOID SPURIOUS TONE CORRECTIONS FOR THOSE SPECTRA
C  WITH MISSING BAND LEVELS.  BY THIS PROCEDURE, THE SPL SPECTRUM
C  IS SEARCHED FOR SPECTRAL IRREGULARITIES ONLY OVER A LIMITED
C  RANGE OF 1/3-OCTAVE BANDS.  THE LIMITED RANGE IS DETERMINED BY
C  STARTING AT THE BAND CONTAINING THE MAXIMUM SPL FOR THE SPECTRUM
C  AND WORKING TOWARD LOWER FREQUENCIES UNTIL THE SPL BECOMES LESS
C  THAN 20.0 DB AND THEN WORKING TOWARD HIGHER FREQUENCIES UNTIL
C  THE SPL AGAIN BECOMES LESS THAN 20.0 DB.  THERE MUST BE AT LEAST
C  6 CONSECUTIVE BANDS CONTAINING SPLS THAT ARE > OR = 20.0 DB FOR
C  THE TONE-CORRECTION CALCULATION TO PROCEED.  IF THERE ARE FEWER
C  THAN 6 BANDS IN THIS RANGE, THEN THE TONE-CORRECTION FACTOR C
C  IS SET = 0.0 DB AND RETURNED TO THE CALLING PROGRAM ALONG WITH
C  JMX=1 FOR THE 50-HZ BAND AS A WARNING.
C
C      USE OF A LIMITED FREQUENCY RANGE TO DETERMINE TONE-CORRECTION
C  FACTORS FOR THE SPL SPECTRUM AT ANY SPECIFIC INSTANT OF TIME IS
C  DERIVED FROM SECTION B36.5(L) OF PART 36 WHERE PERMISSION IS GIVEN
C  TO USE A NARROW BAND ANALYSIS TO PROVE THAT A CALCULATED TONE
C  CORRECTION IS NOT THE RESULT OF AN AIRCRAFT NOISE SOURCE IF IT
C  IS SUSPECTED THAT DISCRETE-FREQUENCY AIRCRAFT NOISES ARE NOT
C  ACTUALLY PRESENT.  THE INTENT OF PARAGRAPH (L) IS ASSUMED TO
C  BE TO CREATE TONE-CORRECTION PENALTIES ONLY FOR SPECTRAL
C  IRREGULARITIES RESULTING FROM DISCRETE-FREQUENCY AIRCRAFT
C  NOISE SOURCES.
C
C      NO ATTEMPT IS MADE TO SYNTHESIZE A COMPLETE 24-BAND
C  SPECTRUM BY ESTIMATING SPLS FOR THOSE BANDS CONTAMINATED BY
C  HIGH BACKGROUND NOISE LEVELS.
C
C*********************************************************************
C
      DIMENSION F(24),JCT(24),S(24),SP(25),SPL(24),SPLP(24),SPLPP(24)
C
C     SET INITIAL VALUES FOR THE TONE-CORRECTION FACTORS.
C
      C=0.0; CMX=0.0
C
```

```
C     SEARCH THE SPL SPECTRUM FROM BAND 14 (1000 HZ) TO BAND 24
C     (10,000 HZ) AND IDENTIFY THE MAXIMUM SPL VALUE AND THE
C     CORRESPONDING BAND NUMBER JM.
C
      SPLM=-1000.0
      DO 20 J=14,24
      IF(SPL(J)-SPLM)20,10,10
   10 JM=J
      SPLM=SPL(J)
   20 CONTINUE
C
C     NOW SEARCH THE SPL SPECTRUM FROM SPLM TO HIGHER FREQUENCIES
C     AND TO LOWER FREQUENCIES TO FIND THE BANDS, IF ANY, WHERE THE
C     SPL FIRST BECOMES LESS THAN 20.0 DB AND NOTE THE CORRESPONDING
C     BAND NUMBERS JL1 AND JH1.
C
      DO 30 J=JM,24
      JH1=J
      IF(SPL(J).LT.20.0)GOTO 40
   30 CONTINUE
      GOTO 50
C
C     IF A BAND LEVEL HAS BEEN FOUND THAT IS < 20.0 DB, THEN RE-SET
C     THE JH1 COUNTER TO THE NEXT LOWER VALUE TO IDENTIFY THE BAND
C     BEFORE THE BAND WHERE THE LEVEL IS < 20.0 DB.
C
   40 JH1=JH1-1
C
   50 DO 60 J=14,JM
C
C     CHANGE TO A NEW COUNTER TO SEARCH THE SPLS FROM THE BAND AT
C     JM BACKWARDS TO LOWER FREQUENCIES.
C
      JL1=JM-J+14
      IF(SPL(JL1).LT.20.0)GOTO 70
   60 CONTINUE
      GOTO 80
C
C     IF A LOW-FREQUENCY BAND LEVEL HAS BEEN FOUND THAT IS < 20.0 DB,
C     RE-SET THE JL1 COUNTER TO THE NEXT HIGHER VALUE.
C
   70 JL1=JL1+1
C
C     JL1 AND JH1 ARE INDICES FOR THE RANGE OF 1/3-OCTAVE BANDS
C     WHERE THE SPLS ARE ALL > OR = 20.0 DB.  TO PROCEED WITH THE
C     CALCULATION OF A TONE-CORRECTION FACTOR, THERE MUST BE AT
C     LEAST 6 BANDS IN THE RANGE FROM JL1 TO JH1.  IF (JH1-JL1-4)
C     IS < 1, THEN THERE ARE AT MOST ONLY 5 BAND LEVELS IN THE
C     RANGE WHICH ARE > OR = 20.0 DB.
C
C     IN THIS CASE, A TONE-CORRECTION FACTOR OF CMX = 0.0 DB IS
C     DECLARED AND RETURNED ALONG WITH THE INDEX JMX=1 (50 HZ)
C     AS A WARNING.
C
   80 IF(JH1-JL1-4)270,270,90
C
```

```
C      FROM HERE TO STATEMENT NUMBER 120 CORRESPONDS TO STEPS 1,2, AND
C      3 OF SECTION B36.5 OF FAR PART 36.
C
C      SET INITIAL VALUES FOR THE FIRST CALCULATION OF BAND-LEVEL
C      SLOPE S(J) AND OF THE FLAG FOR THE BAND INDEX COUNTER JCT(J).
C
 90    S(JL1)=0.0
       JCT(JL1)=0
C
C      SET BAND INDEX COUNTERS FOR 1 AND 2 MORE THAN JL1.
C
       JL2=JL1+1
       JL3=JL2+1
       JCT(JL2)=0
C
C      COMPUTE VALUE OF SECOND BAND SLOPE.
C
       S(JL2)=SPL(JL2)-SPL(JL1)
C
C      COMPUTE BAND-LEVEL CHANGES (SLOPES) FOR REMAINDER OF THE
C      FREQUENCY RANGE TO BAND INDEX JH1.  SET THE JCT(J) FLAG = 1
C      FOR THOSE SPLS WHICH ARE TO BE ENCIRCLED ACCORDING TO RULES
C      OF STEPS 2 AND 3 OF B36.5 OF FAR PART 36.
C
       DO 120 J=JL3,JH1
       JCT(J)=0
       S(J)=SPL(J)-SPL(J-1)
       IF(ABS(S(J)-S(J-1))-5.0)120,120,100
 100   IF(S(J).GT.0.0.AND.S(J).GT.S(J-1))GOTO 110
       IF(S(J).LE.0.0.AND.S(J-1).GT.0.0)JCT(J-1)=1
       GOTO 120
 110   JCT(J)=1
 120   CONTINUE
C
C      FROM HERE TO TWO LINES AFTER STATEMENT NUMBER 160 CORRESPONDS
C  TO STEPS 4 AND 5 OF B36.5 OF FAR PART 36.
C
C      STEP 4-COMPUTE THE INITIAL ESTIMATE, SPLP(J), FOR THE BROADBAND
C  PART OF THE NOISE SPECTRUM.
C
       SPLP(JL1)=SPL(JL1)
       DO 160 J=JL2,JH1
C
C      TEST THE FLAG FOR THE ENCIRCLED BAND LEVELS.
C
       IF(JCT(J))130,130,140
 130   SPLP(J)=SPL(J)
       GOTO 160
C
C      SPECIAL CALCULATION FOR SPLP IF THE FLAG IS SET FOR THE
C  LAST BAND.
C
 140   IF(J.EQ.JH1)GOTO 150
C
C      COMPUTE SPLP(J) FOR ENCIRCLED BAND LEVELS.
```

```
C
      SPLP(J)=0.5*(SPL(J-1)+SPL(J+1))
      GOTO 160
 150  SPLP(J)=SPL(J-1)+S(J-1)
C
C     STEP 5-COMPUTE NEW BAND LEVEL SLOPES, SP(J), FOR THE SPLP(J)
C  VALUES.
C
 160  SP(J)=SPLP(J)-SPLP(J-1)
C
C     COMPUTE VALUE OF SP FOR FIRST BAND AND FOR FICTITIOUS BAND
C  AFTER THE BAND AT JH1.
C
      SP(JL1)=SP(JL2)
      SP(JH1+1)=SP(JH1)
C
C     FROM HERE TO STATEMENT NUMBER 260 CORRESPONDS TO STEPS 6 TO 10
C  IN B36.5 OF FAR PART 36.
C
C     COMPUTE AN INITIAL VALUE FOR THE FINAL ESTIMATE, SPLPP(J), OF
C  THE BROADBAND COMPONENT OF THE NOISE SPECTRUM.
C
      SPLPP(JL1)=SPL(JL1)
      DO 260 J=JL1,JH1
C
C     TEST J TO SEE IF J=JH1.  USE SPECIAL RULE TO FIND F(J) FACTOR
C  WHEN J=JH1.
C
      IF(J-JH1)170,180,180
C
C     STEP 6-COMPUTE THE ARITHMETIC AVERAGE, SA, OF THE 3 ADJACENT
C  SP(J) BAND LEVEL SLOPES.
C
 170  SA=(SP(J)+SP(J+1)+SP(J+2))/3.0
C
C     STEP 7-COMPUTE REMAINDER OF VALUES OF SPLPP(J).
C
      SPLPP(J+1)=SPLPP(J)+SA
C
C     STEP 8-CALCULATE F(J) FACTORS AS THE DIFFERENCE BETWEEN THE
C  ORIGINAL BAND LEVEL, SPL(J), AND THE FINAL ESTIMATE OF THE
C  BROADBAND COMPONENT OF THE NOISE SPECTRUM, SPLPP(J).
C
 180  F(J)=SPL(J)-SPLPP(J)
C
C     NOTE THOSE F(J) VALUES > OR = 0.0 DB.  NEGLECT ANY F(J) < 0.0 DB.
C
      IF(F(J))260,190,190
C
C     STEP 9-FIND TONE-CORRECTION FACTORS C WITH SPECIAL RULE (TABLE
C  B2 OF B36.5 OF FAR PART 36) FOR FREQUENCY BANDS 14 TO 21 (1000
C  TO 5000 HZ).
C
 190  IF(J.GE.14.AND.J.LE.21)GOTO 220
C
```

```
C     COMPUTE TONE-CORRECTION FACTOR C FOR BAND CENTER FREQUENCIES
C  BETWEEN 6300 AND 10,000 HZ AS APPROPRIATE TO THE RANGE
C  FROM JL1 TO JH1.
C
C     NOTE SPECIAL RULE TO LIMIT C IF F(J) > 20.0 DB.
C
      IF(F(J)-20.0)200,210,210
  200 C=F(J)/6.0
      GOTO 250
  210 C=3.3333333
      GOTO 250
C
C     COMPUTE C FOR BAND CENTER FREQUENCIES BETWEEN 1000 AND 5000 HZ.
C
  220 IF(F(J)-20.0)230,240,240
  230 C=F(J)/3.0
      GOTO 250
  240 C=6.6666667
C
C     STEP 10-COMPUTE LARGEST OF C VALUES AND STORE IN CMX.
C
  250 CMX=AMAX(CMX,C)
C
C     TEST CMX AGAINST C TO SET THE BAND INDEX JMX=J WHEN CMX=C.
C
      IF(CMX.EQ.C)JMX=J
  260 CONTINUE
      RETURN
  270 CMX=0.0
C
C     IF THE CALCULATION WAS SENT TO STATEMENT NO. 270, SET
C  JMX=1 AS A WARNING FLAG THAT THERE WERE NOT ENOUGH BANDS
C  WITH SPL > 20.0 DB.
C
      JMX=1
      RETURN
      END
```

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SUBROUTINE INTEG(NS, DATA, DATA10, IF, IL, SUMDAT)

Subroutine INTEG takes the number of samples, NS, the array of input data as a function of time (in dummy array DATA), and the quantity DATA10 (a number which is 10 dB less than the maximum value of DATA) and determines the energy summation, SUMDAT, of the quantities specified by DATA from the first, IF, to the last, IL, time that DATA = DATA10. The DATA array can be tone-corrected perceived noise levels, PNLT, or A-weighted sound pressure levels, AL, or any other quantity which is to be integrated over defined limits. If the input data are PNLT or AL values, then DATA10 is PNLTM-10.0 or ALM-10.0, and SUMDAT is used to calculate effective perceived noise level, EPNL, or sound exposure level, SEL.

INTEG requires about 90 words or about 350 bytes for storage of the source code.

```
C
      SUBROUTINE INTEG(NS,DATA,DATA10,IF,IL,SUMDAT)
C
C**********************************************************************
C
C     SUBROUTINE INTEG DETERMINES THE INDEXES IF AND IL FOR THE FIRST
C     AND LAST OF THE RELATIVE TIMES WHEN THE INPUT DATA ARE EITHER
C     EQUAL OR CLOSEST TO 10-DB LESS THAN THE MAXIMUM VALUE OF THE
C     DATA (I.E., EQUAL OR CLOSEST TO DATA10).
C
C     SUMDAT IS THE ENERGY SUMMATION OF THE DECIBEL VALUES
C     OF THE DATA OVER THE TIME INDEXES FROM IF TO IL.
C
C     DATA IS A DUMMY ARRAY CONTAINING THE INPUT VALUES IN
C     DECIBELS OF PNLT(I) OR AL(I) USED FOR CALCULATIONS
C     OF EPNL OR SEL, RESPECTIVELY.
C
C     NS IS THE NUMBER OF DATA SAMPLES PASSED BY THE CALL STATEMENT
C     IN THE MAIN PROGRAM.
C
C**********************************************************************
C
      DIMENSION DATA(1)
C
C     DETERMINE IF, THE RELATIVE TIME INDEX COUNTER WHERE DATA(I)
C     IS FOR THE FIRST TIME GREATER THAN, OR IS CLOSEST TO, DATA10.
C
      DO 10 I=1,NS
      IF=I
      IF(DATA(I).GT.DATA10)GOTO 20
 10   CONTINUE
C
C     TEST THE VALUE OF IF, OBTAINED FROM THE ABOVE SEARCH FOR
C     THE FIRST TIME INDEX COUNTER, AGAINST THE INITIAL TIME
C     INDEX I=1.
C
 20   IF(IF-1)40,40,30
C
C     WHEN IF IS > 1, THEN TEST THE VALUE OF (DATA(IF)-DATA10) TO
C     SEE IF IT IS LESS THAN THE VALUE OF (DATA10-DATA(IF-1)) AND,
C     IF IT IS NOT, THEN RE-SET THE VALUE OF IF TO THE NEXT SMALLER
C     VALUE (IF=IF-1) TO FIX THE STARTING TIME FOR THE SUMMATION.
C
C     THERE ARE THREE POSSIBLE CASES WHEN IF IS RE-SET TO IF-1:
C     (1) WHEN DATA(IF-1)=DATA10; (2) WHEN DATA(IF) AND DATA(IF-1)
C     ARE MORE AND LESS THAN DATA10 BY EQUAL AMOUNTS; AND (3) WHEN
C     DATA(IF-1) IS LESS THAN DATA10 BY AN AMOUNT THAT IS LESS
C     THAN THE AMOUNT BY WHICH DATA(IF) IS GREATER THAN DATA10.
C
C     THERE ARE TWO POSSIBLE CASES WHEN IF IS NOT RE-SET TO IF-1:
C     (1) WHEN DATA(IF-1) IS LESS THAN DATA10 BY AN AMOUNT THAT
C     IS GREATER THAN THE AMOUNT BY WHICH DATA(IF) IS GREATER
C     THAN DATA10 (I.E., WHEN DATA(IF) IS CLOSER TO DATA10
C     THAN IS DATA(IF-1); AND (2) WHEN IF=1 (I.E., WHEN THE
C     FIRST VALUE OF DATA(I)=DATA(1) IS = OR > DATA10).
```

```
C
 30   IF((DATA(IF)-DATA10).LT.(DATA10-DATA(IF-1)))GOTO 40
      IF=IF-1
C
C     NOW DETERMINE IL, THE RELATIVE-TIME INDEX COUNTER WHERE
C     DATA(I) IS FOR THE LAST TIME GREATER THAN, OR CLOSEST
C     TO, DATA10.
C
 40   DO 50 I=1,NS
      IL=NS-I+1
      IF(DATA(IL).GT.DATA10)GOTO 60
 50   CONTINUE
C
C     TEST THE VALUE OF IL, OBTAINED FROM THE ABOVE SEARCH FOR
C     THE LAST TIME INDEX COUNTER, AGAINST THE LAST TIME
C     INDEX WHEN I=NS.
C
 60   IF(IL-NS)70,80,80
C
C     WHEN IL IS = OR > NS, THEN USE THE VALUE OF IL DETERMINED
C     BY THE ABOVE SEARCH SINCE THIS RESULT MEANS THAT THE LAST
C     VALUE OF DATA(I)=DATA(NS) IS = OR > DATA10.
C
C     WHEN IL IS < NS, THEN RE-SET IL TO IL+1 TO DETERMINE THE
C     RELATIVE-TIME INDEX COUNTER FOR THE VALUE OF DATA(I)
C     WHICH IS EITHER EQUAL, OR CLOSEST TO, THE VALUE OF DATA10.
C
 70   IF((DATA(IL)-DATA10).LT.(DATA10-DATA(IL+1)))GOTO 80
      IL=IL+1
C
C     NOW DETERMINE THE SUMMATION, ON AN ENERGY BASIS, OF THE
C     INPUT VALUES OF DATA(I) IN DECIBELS BETWEEN THE 10-DB-DOWN
C     TIMES IF TO IL.
C
 80   SUMDAT=0.0
      DO 90 I=IF,IL
 90   SUMDAT=SUMDAT+10.0**(DATA(I)/10.0)
C
C     RETURN TO THE MAIN PROGRAM WITH THE VALUES OF IF, IL,
C     AND SUMDAT.
C
      RETURN
      END
```

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SUBROUTINE MOLAR(TK, HR, PA, WV)

Subroutine MOLAR calculates the molar concentration, WV, of water vapor in the air, in percent, for given air temperature, TK, relative humidity, HR, and air pressure, PA.

MOLAR requires about 85 words or about 350 bytes for storage.

```
C
      SUBROUTINE MOLAR (TK,HR,PA,WV)
C
C************************************************************************
C
C         SUBROUTINE MOLAR CALCULATES WV, THE MOLAR CONCENTRATION OF
C     WATER VAPOR IN THE AIR IN PERCENT.  A WV VALUE IS CALCULATED
C     FOR THE AIR TEMPERATURE, RELATIVE HUMIDITY, AND AIR PRESSURE
C     SPECIFIED BY THE CALLING ROUTINE.
C
C       TK    IS AIR TEMPERATURE, DEG KELVIN
C
C       HR    IS RELATIVE HUMIDITY, PERCENT
C
C       PA    IS AIR PRESSURE, STANDARD ATMOSPHERES
C
C       WV    IS MOLAR CONCENTRATION OF WATER VAPOR, PERCENT
C
C************************************************************************
C
      REAL LPSOP0
      T0=293.15
      T01=273.16
      LPSOP0=10.79586*(1.-(T01/TK)) - 5.02808*LOG10(TK/T01)
     1        +1.50474E-4*(1.-10.**(-8.29692*((TK/T01)-1.)))
     2        +0.42873E-3*(10.**(4.76955*(1.-(T01/TK)))-1.)
     3        -2.2195983
      PSOP0=10.**LPSOP0
      WV=HR*PSOP0/PA
      RETURN
      END
```

SUBROUTINE ARP866A(J, TC, HR, ALPHA)

Subroutine ARP866A uses the procedure of SAE ARP866A (March 1975) to calculate the pure-tone atmospheric absorption coefficient, ALPHA in dB/m, applicable to a 1/3-octave band specified by index counter J and for given temperature, TC, and relative humidity HR. TC is in degrees celsius and HR is in percent.

ARP866A requires about 280 words or about 1100 bytes for storage.

```
C
      SUBROUTINE ARP866A (J,TC,HR,ALPHA)
C
C*****************************************************************
C
C   J  IS THE INDEX COUNTER FOR THE GEOMETRIC MEAN FREQUENCY OF
C      THE 1/3-OCTAVE BANDS FROM 50 TO 10,000 HZ.
C
C   TC   IS AIR TEMPERATURE, DEGREES CELSIUS.
C
C   HR   IS RELATIVE HUMIDITY OF THE AIR, PERCENT.
C
C   ALPHA IS THE VALUE OF THE ATMOSPHERIC ABSORPTION COEFFICIENT IN
C       DB/M CALCULATED BY THE METHOD OF SAE ARP 866A, MARCH 1975.
C
C*******************************************************************
C
      DIMENSION FREQ(24),TABLE(58)
      DATA TABLE /0.00,0.00,0.250,0.315,0.50,0.70,0.6,0.84,0.7,0.93,
     10.8,0.975,0.9,0.996,1.0,1.0,1.1,0.97,1.2,0.9,1.3,0.84,1.5,0.75,
     21.7,0.67,2.0,0.57,2.3,0.495,2.5,0.45,2.8,0.4,3.0,0.37,3.30,0.33,
     33.6,0.3,4.15,0.26.4.45,0.245,4.80,0.23,5.25,0.22,5.7,0.21,
     46.05,0.205,6.5,0.2,7.0,0.2,10.0,0.2/
      DATA FREQ /50.,63.,80.,100.,125.,160.,200.,250.,315.,400.,500.,
     1630.,800.,1000.,1250.,1600.,2000.,2500.,3150.,4000.,4500.,
     25600.,7100.,9000./
      B=1.328924-3.179768E-02*TC+2.173716E-04*TC**2.-1.7496E-06*TC**3.
      ABSHUM=10.0**(LOG10(HR)-B)
      AMOLMX=10.0**(LOG10(FREQ(J))+8.42994E-03*TC-2.755624)
      HMOLMX=SQRT(FREQ(J)/1010.)
      HUMRAT=ABSHUM/HMOLMX
      L=2
      IF(HUMRAT.LE.TABLE(1))GOTO 40
      DO 10 I=3,57,2
      L=I+1
      IF(TABLE(I)-HUMRAT)10,40,20
   10 CONTINUE
      GOTO 40
   20 I=I-2
      IF(I.GE.3)GOTO 30
      I=I+2
   30 XA1=HUMRAT-TABLE(I)
      XA0=HUMRAT-TABLE(I-2)
      XA2=HUMRAT-TABLE(I+2)
      X01=TABLE(I-2)-TABLE(I)
      X02=TABLE(I-2)-TABLE(I+2)
      X12=TABLE(I)-TABLE(I+2)
      ALPRAT=TABLE(I-1)*(XA1/X01)*(XA2/X02)
     1        -TABLE(I+1)*(XA0/X01)*(XA2/X12)
     2        +TABLE(I+3)*(XA0/X02)*(XA1/X12)
      GOTO 50
   40 ALPRAT=TABLE(L)
   50 ALPMOL=ALPRAT*AMOLMX
      ALPCLA=10.0**(2.05*LOG10(FREQ(J)/1000.) + 1.1394E-03*TC
     1        - 1.916984)
      ALPHA=0.01*(ALPCLA + ALPMOL)
      RETURN
      END
```

SUBROUTINE ANSAB(TK, HR, PA, F, A)

Subroutine ANSAB uses the procedure of American National Standard ANS S1.26-1978 to calculate the pure-tone atmospheric absorption of sound A, in dB/m, at frequency F, in Hz, for given air temperature TK, in degrees kelvin, relative humidity HR, in percent, and air pressure PA, in standard atmospheres.

ANSAB requires about 200 words or about 850 bytes for storage.

```
C
      SUBROUTINE ANSAB (TK,HR,PA,F,A)
C
C**************************************************************
C
C       SUBROUTINE ANSAB CALCULATES PURE-TONE SOUND ABSORPTION
C   COEFFICIENTS ACCORDING TO THE PROCEDURE OF AMERICAN NATIONAL
C   STANDARD ANS S1.26-1978 FOR THE ATMOSPHERIC ABSORPTION OF
C   SOUND.
C
C       TK IS AIR TEMPERATURE, DEGREES KELVIN.
C
C       HR IS THE RELATIVE HUMIDITY OF THE AIR, PERCENT.
C
C       PA IS THE PRESSURE OF THE AIR, STANDARD ATMOSPHERES.
C
C       F  IS THE FREQUENCY OF THE SOUND, HZ.
C
C       A  IS THE PURE-TONE ATMOSPHERIC SOUND ABSORPTION COEFFICIENT,
C    DB/M.
C
C       T0 AND T01 ARE REFERENCE TEMPERATURES, DEGREES KELVIN.
C
C       LPSOP0 IS THE LOGARITHM OF THE RATIO OF THE VAPOR PRESSURE
C   AT SATURATION TO THE STANDARD ATMOSPHERIC PRESSURE, I.E., THE
C   LOGARITHM OF PSOP0.
C
C       H  IS THE MOLAR CONCENTRATION OF WATER VAPOR, PERCENT.
C
C       FRO2 AND FRN2 ARE THE RELAXATION FREQUENCIES OF OXYGEN
C   AND NITROGEN, RESPECTIVELY, HERTZ.
C
C       ALPHA IS THE ATMOSPHERIC ABSORPTION COEFFICIENT,
C   NEPERS/M.
C
C**************************************************************
C
      REAL LPSOP0
      T0=293.15
      T01=273.16
      LPSOP0=10.79586*(1.-(T01/TK)) - 5.02808*LOG10(TK/T01)
     1        +1.50474E-4*(1.-10.**(-8.29692*((TK/T01)-1.)))
     2        +0.42873E-3*(10.**(4.76955*(1.-(T01/TK)))-1.)
     3        -2.2195983
      PSOP0=10.**LPSOP0
      H=HR*PSOP0/PA
      FRO2=PA*(24.+4.41E04*H*((0.05+H)/(0.391+H)))
      FRN2=(PA/SQRT(TK/T0))*(9.+
     1       350.*H*EXP(-6.142*(((TK/T0)**(-1./3.))-1.)))
      ALPHA=(F**2.)*(((1.84E-11)*(1./PA)*SQRT(TK/T0))
     1       +((TK/T0)**(-5./2.))*((1.278E-2*
     2       (EXP(-2239.1/TK))/(FRO2+((F**2.)/FRO2)))
     3       +(0.1068*(EXP(-3352./TK))/(FRN2+((F**2.)/FRN2)))))
      A=8.686*ALPHA
      RETURN
      END
```

SUBROUTINE NUMINT (SPL, TKR, HRR, PAR, ATK, AHR, PA, D, KL, BA)

Subroutine NUMINT calculates the array of band adjustment factors BA, in decibels, appropriate for the set of measured test-day 1/3-octave-band sound pressure levels specified in dummy array SPL. The reference atmospheric conditions (given by parameters TKR, HRR, and PAR) and the test-day atmospheric conditions as a function of height above ground level (given by arrays ATK and AHR) and the uniform pressure PA are specified by the calling program as is the array D of pathlength segments along the sound propagation path from the microphone back to the aircraft at its position on the flight path at the time it emitted the sound measured by the microphone as the sound pressure levels SPL.

Subroutine NUMINT uses a numerical integration technique to integrate the product of an equivalent, normalized sound pressure spectral density function and an absorption function over the sound propagation path for the two atmospheric conditions and thereby calculate a band adjustment factor for ideal 1/3-octave-band filters.

Subroutine DIFFS is called to calculate a set of band-level differences, or slopes, for the input SPL array. The differences are used in the approximation of the sound pressure spectral density function over the bandwidth of each filter.

Subroutine ANSAB is called to determine a pure-tone sound absorption coefficient at specified frequencies over the filter bandwidth and over the sound propagation path.

Subroutine QSF is called to perform the actual numerical integration, at equally spaced frequency intervals, of the calculated integrand values over the bandwidth of the ideal filter.

NUMINT requires about 470 computer words or about 1900 bytes for storage.

```
C
      SUBROUTINE NUMINT(SPL,TKR,HRR,PAR,ATK,AHR,PA,D,KL,BA)
C
C**********************************************************************
C
C       SUBROUTINE NUMINT USES A NUMERICAL INTEGRATION TECHNIQUE
C    TO CALCULATE AN ADJUSTMENT FACTOR TO BE APPLIED TO 1/3-
C    OCTAVE-BAND SOUND PRESSURE LEVELS TO ACCOUNT FOR DIFFERENCES
C    IN THE ATMOSPHERIC ABSORPTION OF SOUND OVER A SEGMENTED SOUND
C    PROPAGATION PATH UNDER TWO DIFFERENT SETS OF METEOROLOGICAL
C    CONDITIONS, I.E., TEST AND REFERENCE CONDITIONS.
C
C    SPL --  THE ARRAY OF 24 MEASURED 1/3-OCTAVE-BAND SPLS
C            WITH NOMINAL BAND CENTER FREQUENCIES BETWEEN 50 AND
C            10,000 HZ, DB.
C
C    TKR --  THE REFERENCE AIR TEMPERATURE, DEG KELVIN.
C
C    HRR --  THE REFERENCE RELATIVE HUMIDITY OF THE AIR, PERCENT.
C
C    PAR --  THE REFERENCE ATMOSPHERIC PRESSURE, STANDARD ATMO-
C            SPHERES.
C
C    ATK --  THE ARRAY OF AVERAGE AIR TEMPERATURES, OVER EACH
C            SEGMENT OF THE SOUND PROPAGATION PATH, MEASURED AT
C            THE TIME THE MEASURED SPLS WERE OBTAINED, DEG KELVIN.
C
C    AHR --  THE ARRAY OF AVERAGE RELATIVE HUMIDITIES, OVER EACH
C            SEGMENT OF THE SOUND PROPAGATION PATH, MEASURED AT THE
C            TIME THE MEASURED SPLS WERE OBTAINED, PERCENT.
C
C    PA --  THE ATMOSPHERIC PRESSURE AT THE TIME THE MEASURED
C           SPLS WERE OBTAINED, STANDARD ATMOSPHERES.
C
C    D --  THE ARRAY OF DISTANCES ALONG THE SEGMENTS OF THE SOUND
C          PROPAGATION PATH CORRESPONDING TO THE HORIZONTAL LAYERS
C          DEFINED BY THE INTERVALS OF HEIGHT WHERE THE AIR
C          TEMPERATURE AND RELATIVE HUMIDITY WERE MEASURED, METERS.
C
C    KL --  THE INDEX COUNTER FOR THE ARRAYS ATK, AHR, AND D THAT
C           INDICATES THE LAST INCREMENT ALONG THE PATH FROM
C           THE MICROPHONE TO THE AIRPLANE.
C
C    BA --  THE BAND-ADJUSTMENT FACTOR TO BE ADDED TO THE
C           MEASURED SPL TO DETERMINE THE SPL THAT WOULD HAVE BEEN
C           MEASURED UNDER REFERENCE METEOROLOGICAL CONDITIONS, DB.
C
C***     SUBROUTINE NUMINT CALLS SUBROUTINE DIFFS TO DETERMINE THE BAND
C        LEVEL DIFFERENCES, OR DATA SLOPES, IN DB/BAND OVER THE
C        LOWER AND UPPER HALVES OF EACH OF THE 24 FILTER BANDS
C        CORRESPONDING TO THE BAND LEVELS IN THE ARRAY SPL.
C
C***     SUBROUTINE NUMINT ALSO CALLS SUBROUTINE ANSAB TO DETERMINE
C        PURE-TONE ATMOSPHERIC ABSORPTION COEFFICIENTS, IN DB/M,
C        AS A FUNCTION OF FREQUENCY FOR SPECIFIED AIR TEMPERATURE,
C        RELATIVE HUMIDITY, AND AIR PRESSURE.
```

```
C
C***  THE ACTUAL PROCESS OF NUMERICALLY INTEGRATING THE ARRAY
C     OF CALCULATED INTEGRAND VALUES OVER THE BANDWIDTH
C     OF THE 1/3-OCTAVE-BAND FILTERS (ASSUMED TO BE IDEAL
C     FILTERS) IS PERFORMED BY A STANDARD ROUTINE DESCRIBED
C     IN SUBROUTINE QSF WHICH IS ALSO CALLED BY SUBROUTINE
C     NUMINT.
C
C***  NOTE THAT A VARIETY OF COMPARABLE NUMERICAL INTEGRATION
C  METHODS COULD BE SUBSTITUTED FOR SUBROUTINE QSF WITH
C  APPROPRIATE MODIFICATIONS TO THE PROGRAM STATEMENTS.
C
C*************************************************************
C
      DIMENSION AHR(31),ATK(31),BA(24),D(31),NSTEP(24),
     1SLOPE(24,2),SPL(25),YNL(16),YNU(16),ZNL(16),ZNU(16)
C
      DATA NSTEP/13*4,5,6,7,8,9,10,11,12,13,14,15/
C
C     THE DIMENSIONS OF THE ARRAYS HAVE BEEN SET TO SPECIFIC
C  VALUES TO AGREE WITH THE CORRESPONDING ARRAYS IN THE
C  CALLING ROUTINE, OR, IN THE CASE OF THE Y AND Z ARRAYS,
C  TO 1 MORE THAN THE LARGEST NUMBER OF FREQUENCY STEPS, NSTEP,
C  OVER THE WIDEST BANDWIDTH OF EACH HALF OF THE IDEAL
C  FILTER AT BAND 24 (10,000 HZ).
C
C     DEFINE RF, THE EXACT VALUE OF THE FREQUENCY RATIO
C  FOR 1/3-OCTAVE BANDS.
C
      RF=10.0**0.1
C
C     DETERMINE FC, THE EXACT BAND CENTER FREQUENCY, IN HZ,
C  FROM THE DEFINITION BASED ON THE SET OF INTERNATIONAL
C  STANDARD BAND NUMBERS, ISBN, STARTING WITH ISBN=17 FOR
C  THE FIRST BAND, J=1, WITH NOMINAL CENTER FREQUENCY OF 50 HZ.
C
      DO 30 J=1,24
C
      ISBN=16+J
      FC=10.0**(ISBN/10.0)
C
C     CALCULATE THE EXACT LOWER, FL, AND UPPER, FU, BANDEDGE
C  FREQUENCIES FOR THE FILTER BAND.
C
C     CALCULATE THE FREQUENCY INTERVALS FOR THE LOWER, DELFL,
C  AND UPPER, DELFU, HALVES OF THE FILTER BAND.
C
      FL=FC/SQRT(RF)
      FU=FC*SQRT(RF)
C
      DELFL=(FC-FL)/NSTEP(J)
      DELFU=(FU-FC)/NSTEP(J)
C
C     ASSIGN THE VALUES FOR THE FREQUENCIES F1 AND F2 BEFORE
C  THE START OF THE NUMERICAL INTEGRATION OVER THE LOWER
C  AND UPPER HALVES OF THE FILTER BAND.
```

```
C
      F1=FL-DELFL
      F2=FC-DELFU
C
C     CALCULATE NN, THE TOTAL NUMBER OF STEPS (OR FREQUENCY
C  INTERVALS) IN THE NUMERICAL INTEGRATION OVER EACH HALF
C  OF A FILTER BAND.
C
      NN=NSTEP(J)+1
C
C     FIND THE BAND-LEVEL SLOPES, IN DB/BAND, CORRESPONDING
C  TO THE INPUT SPLS.
C
      CALL DIFFS(SPL,SLOPE)
C
C     CALCULATE SPSL AND SPSU FOR THE ESTIMATED SLOPES OF THE
C  NORMALIZED SOUND PRESSURE SPECTRAL DENSITY FUNCTIONS OVER
C  THE LOWER AND UPPER HALVES OF THE FILTER BAND BY USING THE
C  CORRESPONDING BAND-LEVEL SLOPES.
C
      SPSL=SLOPE(J,1)/(10.0*LOG10(RF))
      SPSU=SLOPE(J,2)/(10.0*LOG10(RF))
C
C     TEST THE VALUE OF THE SLOPES TO DETERMINE WHICH FORM TO
C  USE FOR CALCULATING THE DENOMINATOR TERMS FOR THE LOWER HALF
C  OF THE BAND, DEN1, AND THE UPPER HALF OF THE BAND, DEN2.
C
      IF(SPSL.NE.0.0)DEN1=(FC/SPSL)*(1.-(RF**(-SPSL/2.)))
      IF(SPSL.EQ.0.0)DEN1=(FC/2.)*LOG(RF)
C
      IF(SPSU.NE.0.0)DEN2=(FC/SPSU)*((RF**(SPSU/2.))-1.)
      IF(SPSU.EQ.0.0)DEN2=(FC/2.)*LOG(RF)
C
C     DETERMINE THE ARRAY OF INTEGRAND VALUES FOR THE NUMERATOR
C  TERMS OVER THE LOWER AND UPPER HALVES OF A FILTER BAND.
C
      DO 20 JJ=1,NN
C
C     DETERMINE THE FREQUENCY AT EACH STEP IN THE LOWER, F1,
C  AND UPPER, F2, HALF OF THE BANDWIDTH.
C
      F1=F1+DELFL
      F2=F2+DELFU
C
C     DETERMINE THE VALUE OF THE NORMALIZED SOUND PRESSURE
C  SPECTRAL DENSITY FUNCTION AT FREQUENCIES F1 AND F2.
C
      XL=(F1/FC)**(-1.+SPSL)
      XU=(F2/FC)**(-1.+SPSU)
C
C     DETERMINE THE ATMOSPHERIC ABSORPTION COEFFICIENTS FOR
C  THE REFERENCE METEOROLOGICAL CONDITIONS AT FREQUENCIES
C  F1 AND F2 WITH THE ASSUMPTION OF A UNIFORM REFERENCE ATMOSPHERE.
```

```
C
      CALL ANSAB(TKR,HRR,PAR,F1,AR1)
      CALL ANSAB(TKR,HRR,PAR,F2,AR2)
C
C     DETERMINE THE EXPONENT, AE, OF THE ATMOSPHERIC-ABSORPTION
C  ATTENUATION FACTOR, AF, BY SUMMING THE DIFFERENCES IN
C  ATTENUATION UNDER TEST AND REFERENCE METEOROLOGICAL CONDITIONS
C  OVER THE SEGMENTS ALONG THE LENGTH OF THE SOUND PROPAGATION
C  PATH.
C
         AEL=AEU=0.0
         DO 10 K=1,KL
         CALL ANSAB(ATK(K),AHR(K),PA,F1,A1)
         CALL ANSAB(ATK(K),AHR(K),PA,F2,A2)
         AEL=AEL+(A1-AR1)*D(K)
 10      AEU=AEU+(A2-AR2)*D(K)
C
      AFL=10.0**(AEL/10.0)
      AFU=10.0**(AEU/10.0)
C
C     DETERMINE THE VALUES OF THE NUMERATOR INTEGRANDS AS THE
C  PRODUCTS OF THE NORMALIZED EQUIVALENT SOUND PRESSURE SPECTRAL
C  DENSITY FUNCTIONS AND THE ATMOSPHERIC-ABSORPTION FACTORS.
C     STORE THE RESULTS IN ARRAYS YNL AND YNU.
C
      YNL(JJ)=XL*AFL
 20   YNU(JJ)=XU*AFU
C
C     CALL THE NUMERICAL INTEGRATION SUBROUTINE QSF TO
C  INTEGRATE THE INTEGRAND ARRAYS OVER THE LOWER AND UPPER
C  HALVES OF THE FILTER BANDWIDTH.
C
      CALL QSF(DELFL,YNL,ZNL,NN)
      CALL QSF(DELFU,YNU,ZNU,NN)
C
C     THE LAST VALUE AT NN OF THE OUTPUT ARRAYS ZNL AND ZNU
C  IS THE RESULT OF THE NUMERICAL INTEGRATION OVER
C  THE RANGE OF FREQUENCIES IN EACH HALF OF THE FILTER BAND.
C
C     DETERMINE THE BAND ADJUSTMENT FACTOR, BA, FROM
C  THE RESULTS OF THE NUMERICAL INTEGRATIONS.
C
 30   BA(J)=10.0*LOG10((ZNL(NN)+ZNU(NN))/(DEN1+DEN2))
C
      RETURN
      END
```

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SUBROUTINE DIFFS(SPL, SLOPE)

Subroutine DIFFS accepts an array of 24 1/3-octave-band sound pressure levels and calculates the spectral slopes (SLOPE) or band-level differences over the lower and upper halves of each band. Special rules are defined for the first and last bands and for handling bands where the indicated sound pressure level has been set equal to 0.0 dB because the signal level was not more than 5.0 dB greater than the corresponding background noise level.

DIFFS requires about 170 words or about 700 bytes for storage of the source code.

```
C
      SUBROUTINE DIFFS(SPL,SLOPE)
C
C*****************************************************************************
C
C     SUBROUTINE DIFFS COMPUTES THE DIFFERENCES IN THE LEVEL OF
C  THE 1/3-OCTAVE-BAND SOUND PRESSURE LEVELS OVER THE LOWER AND
C  UPPER HALVES OF EACH OF THE 24 BANDS WITH CENTER FREQUENCIES
C  FROM 50 HZ TO 10,000 HZ.  THE LOWER HALF OF A BAND IS
C  DEFINED TO BE FROM THE LOWER BANDEDGE FREQUENCY TO THE
C  EXACT GEOMETRIC MEAN FREQUENCY; THE UPPER HALF IS FROM THE
C  GEOMETRIC MEAN FREQUENCY TO THE UPPER BANDEDGE FREQUENCY.
C  THE FILTER BANDS ARE ASSUMED TO HAVE IDEAL TRANSMISSION
C  RESPONSE CHARACTERISTICS.
C
C      SPL   THE ARRAY OF 24 SOUND PRESSURE LEVELS, IN DB,
C            PASSED BY THE CALLING PROGRAM PLUS A LEVEL
C            OF 0.0 DB FOR A FICTITIOUS BAND 25.
C
C      SLOPE     THE ARRAY OF LOWER AND UPPER BAND-LEVEL
C           DIFFERENCES, OR SLOPES, CALCULATED FOR EACH
C           OF THE 24 BANDS, IN DB/BAND.
C
C**********************************************************************************
C
      DIMENSION SLOPE(24,2),SPL(25),SS(24)
C
      DATA SS/3*1.,13*0.,-1.,-2.,-3.,-4.,-5.,-7.,-10.,-15./
C
      SPL(25)=0.0
C
      DO 70 J=1,23
      IF(J.LT.23)GOTO 10
C
C     SPECIAL RULE FOR BAND 24 (10,000 HZ) WHEN SPL(24) IS > 0.0 DB,
C  BUT SPL(23) IS < OR = 0.0 DB.
C
      IF(SPL(24).GT.0.0.AND.SPL(23).LE.0.0)GOTO 80
C
C     ANOTHER SPECIAL RULE FOR BAND 24 WHEN SPL(23) IS > 0.0 DB
C  BUT SPL(24) IS < OR = 0.0 DB.
C
      IF(SPL(23).GT.0.0.AND.SPL(24).LE.0.0)GO TO 90
C
C     ANOTHER SPECIAL RULE FOR BAND 24 WHEN SPL(23) AND SPL(24)
C  ARE BOTH < OR = 0.0 DB.
C
      IF(SPL(23).LE.0.0.AND.SPL(24).LE.0.0)GOTO 100
C
C     IF SPL(J) IS < OR = 0.0 DB, THEN IN ORDER TO HAVE SOME
C  SPECIFIC VALUE TO USE IN SUBSEQUENT CALCULATIONS SET THE SLOPE
C  FOR THIS BAND ARBITRARILY TO +1 DB/BAND.
C
C     A SLOPE OF +1 DB/BAND REPRESENTS A WHITE-NOISE SPECTRUM AND,
C  WITH SUBROUTINE NUMINT, YIELDS A MEASURE OF THE "AVERAGE"
C  ATTENUATION OVER THE FREQUENCY RANGE OF THE 1/3-OCTAVE BAND.
```

```
C
 10   IF(SPL(J).LE.0.0)GOTO 60
      IF(J.GT.1)GOTO 20
C
C     SPECIAL RULE FOR BAND 1 (50 HZ) WHEN SPL(1) IS > 0.0 DB,
C  BUT SPL(2) IS < OR = 0.0 DB.
C
      IF(SPL(2).LE.0.0)GOTO 50
      IF(J.EQ.1)GOTO 30
C
C     SPECIAL RULE FOR THE CASE WHEN J IS BETWEEN 2 AND 23
C  AND SPL(J) IS > 0.0 DB, BUT SPL(J-1) AND SPL(J+1) ARE
C  BOTH < OR = 0.0 DB.
C
 20   IF(SPL(J-1).LE.0.0.AND.SPL(J+1).LE.0.0)GOTO 50
C
C     PROCEED WITH NORMAL CALCULATION OF BAND-LEVEL SLOPES
C  WHEN SPL(J) AND SPL(J+1) ARE BOTH > 0.0 DB.
C
      IF(SPL(J+1).GT.0.0)GOTO 30
C
C     IF SPL(J) > 0.0 DB, BUT SPL(J+1) IS < OR = 0.0 DB, THEN
C  SKIP SLOPE CALCULATION BY NORMAL PROCEDURE BECAUSE THIS CASE
C  IS TREATED AS THOUGH THE BAND WHERE SPL(J) IS > 0.0 DB IS
C  THE LAST BAND WITH VALID DATA AND THE SEARCH STARTS OVER
C  AGAIN AT SPL(J+2).  THE SLOPE FOR THE UPPER HALF OF THE BAND
C  AT J IS EXTRAPOLATED FROM THE SLOPE CALCULATED FOR THE
C  LOWER HALF.  THE ARBITRARY SLOPE OF +1 DB/BAND IS CALCULATED
C  FOR THE BAND AT J+1 IN THIS CASE.
C
      GOTO 70
C
C     FIRST, FIND SLOPE OVER UPPER HALF OF BAND AT J.
C
 30   SLOPE(J,2)=SPL(J+1)-SPL(J)
C
C     SLOPE OVER LOWER HALF OF BAND AT J+1=SLOPE OVER UPPER
C  HALF OF BAND AT J.
C
      SLOPE(J+1,1)=SLOPE(J,2)
      IF(J.GT.1)GOTO 40
C
C     SPECIAL RULE FOR SLOPE OVER LOWER HALF OF BAND 1 WHEN
C  SPL(1) AND SPL(2) ARE BOTH > 0.0 DB.
C
      SLOPE(1,1)=SLOPE(1,2)
      GOTO 70
C
C     SPECIAL RULE FOR THE SLOPE OVER THE UPPER HALF OF THE
C  BAND AT J+1 WHEN SPL(J) AND SPL(J+1) ARE BOTH > 0.0 DB,
C  BUT THE SPL(J+2) IS < OR = 0.0 DB.  THIS RULE ALSO APPLIES
C  TO BAND 24 WHEN SPL(23) AND SPL(24) ARE BOTH > 0.0 DB
C  SINCE SPL(25) IS ARBITRARILY SET = 0.0 DB.
C
 40   IF(SPL(J+2).LE.0.0)SLOPE(J+1,2)=SLOPE(J+1,1)
```

```
C
C     SPECIAL RULE FOR THE SLOPE OVER THE LOWER HALF OF THE BAND
C  AT J IF SPL(J-1) IS < OR = 0.0 DB AND J IS > 1.
C
      IF(SPL(J-1).LE.0.0)SLOPE(J,1)=SLOPE(J,2)
      GOTO 70
C
C     FOR THOSE BANDS WHERE SPL IS > 0.0 DB BUT SPL(J-1) AND
C  SPL(J+1) ARE BOTH < OR = 0.0 DB, USE THE ARBITRARY SUBSTITUTE
C  BAND-LEVEL SLOPES SS(J) FROM THE DATA STATEMENT.
C
 50   SLOPE(J,1)=SLOPE(J,2)=SS(J)
      GOTO 70
C
C     SPECIAL RULE FOR BANDS WHERE SPL(J) IS < OR = 0.0 DB.
C
 60   SLOPE(J,1)=SLOPE(J,2)=1.0
C
 70   CONTINUE
C
      RETURN
C
C     SPECIAL RULE FOR BAND 24 WHEN SPL(24) IS > 0.0 DB
C  BUT SPL(23) IS < OR = 0.0 DB.
C
 80   SLOPE(23,1)=SLOPE(23,2)=1.0
      SLOPE(24,1)=SLOPE(24,2)=SS(24)
      RETURN
C
C     SPECIAL RULE FOR BAND 24  WHEN SPL(23) IS > 0.0 DB,
C  BUT SPL(24) IS < OR = 0.0 DB.
C
 90   SLOPE(24,1)=SLOPE(24,2)=1.0
      RETURN
C
C     SPECIAL RULE FOR BANDS 23 AND 24 WHEN BOTH SPL(23) AND
C  SPL(24) ARE < OR = 0.0 DB.
C
 100  SLOPE(23,1)=SLOPE(23,2)=SLOPE(24,1)=SLOPE(24,2)=1.0
      RETURN
C
      END
```

SUBROUTINE QSF(H, Y, Z, NDIM)

Subroutine QSF numerically integrates the array of function values Y to determine the array of integral values Z at the specified increment H for the argument of Y. NDIM is the dimension of arrays Y and Z. A combination of Simpson's and Newton's rules is used to perform the calculations. The QSF program is taken from the IBM Scientific Subroutine Package. It is included here for completeness. Other numerical integration methods could be used in place of QSF with appropriate modifications to Subroutine NUMINT.

QSF requires about 310 words or about 1250 bytes for storage.

```
C
      SUBROUTINE QSF(H,Y,Z,NDIM)
C
C**********************************************************************C
C
C     SUBROUTINE QSF FROM IBM SCIENTIFIC SUBROUTINE PACKAGE (SSP),
C     FIFTH EDITION,AUGUST 1970.
C
C     PURPOSE
C        TO COMPUTE THE ARRAY OF INTEGRAL VALUES FOR A GIVEN
C        EQUIDISTANT TABLE OF FUNCTION VALUES.
C
C     USAGE
C        CALL QSF (H,Y,Z,NDIM)
C
C     DESCRIPTION OF PARAMETERS
C        H    -THE INCREMENT OF ARGUMENT VALUES.
C        Y    -THE INPUT ARRAY OF FUNCTION VALUES.
C        Z    -THE RESULTING ARRAY OF INTEGRAL VALUES.  Z MAY BE
C              IDENTICAL WITH Y.
C      NDIM   -THE DIMENSION OF ARRAYS Y AND  Z.
C
C     REMARKS
C        NO ACTION IN CASE NDIM LESS THAN 3.
C        NO SUBROUTINES OR FUNCTION SUBPROGRAMS ARE REQUIRED.
C
C     METHOD
C        BEGINNING WITH Z(1)=0, EVALUATION OF ARRAY Z IS DONE BY
C        MEANS OF SIMPSON'S RULE TOGETHER WITH NEWTON'S 3/8 RULE OR
C        A COMBINATION OF THESE TWO RULES.  TRUNCATION ERROR IS OF
C        ORDER H**5 (I.E.,FOURTH ORDER METHOD).  ONLY IN CASE NDIM=3
C        IS THE TRUNCATION ERROR OF Z(2) OF ORDER H**4.
C
C**********************************************************************C
C
      DIMENSION Y(1),Z(1)
C
      HT=0.3333333*H
      IF(NDIM-5)7,8,1
C
C     NDIM IS GREATER THAN 5.  PREPARATION OF INTEGRATION LOOP.
C
    1 SUM1=Y(2)+Y(2)
      SUM1=SUM1+SUM1
      SUM1=HT*(Y(1)+SUM1+Y(3))
      AUX1=Y(4)+Y(4)
      AUX1=AUX1+AUX1
      AUX1=SUM1+HT*(Y(3)+AUX1+Y(5))
      AUX2=HT*(Y(1)+3.875*(Y(2)+Y(5))+2.625*(Y(3)+Y(4))+Y(6))
      SUM2=Y(5)+Y(5)
      SUM2=SUM2+SUM2
      SUM2=AUX2-HT*(Y(4)+SUM2+Y(6))
      Z(1)=0.0
      AUX=Y(3)+Y(3)
      AUX=AUX+AUX
      Z(2)=SUM2-HT*(Y(2)+AUX+Y(4))
      Z(3)=SUM1
      Z(4)=SUM2
      IF(NDIM-6)5,5,2
```

```
C
C     INTEGRATION LOOP.
C
    2 DO 4 I=7,NDIM,2
      SUM1=AUX1
      SUM2=AUX2
      AUX1=Y(I-1)+Y(I-1)
      AUX1=AUX1+AUX1
      AUX1=SUM1+HT*(Y(I-2)+AUX1+Y(I))
      Z(I-2)=SUM1
      IF(I-NDIM)3,6,6
    3 AUX2=Y(I)+Y(I)
      AUX2=AUX2+AUX2
      AUX2=SUM2+HT*(Y(I-1)+AUX2+Y(I+1))
    4 Z(I-1)=SUM2
    5 Z(NDIM-1)=AUX1
      Z(NDIM)=AUX2
      RETURN
    6 Z(NDIM-1)=SUM2
      Z(NDIM)=AUX1
      RETURN
C
C     END OF INTEGRATION LOOP FOR NDIM GREATER THAN 5.
```

```
C
    7     IF (NDIM-3)12,11,8
C
C         NDIM IS EQUAL TO 4 OR 5.
C
    8     SUM2=1.125*HT*(Y(1)+Y(2)+Y(2)+Y(2)+Y(3)+Y(3)+Y(3)+Y(4))
          SUM1=Y(2)+Y(2)
          SUM1=SUM1+SUM1
          SUM1=HT*(Y(1)+SUM1+Y(3))
          Z(1)=0.0
          AUX1=Y(3)+Y(3)
          AUX1=AUX1+AUX1
          Z(2)=SUM2-HT*(Y(2)+AUX1+Y(4))
          IF(NDIM-5)10,9,9
C
C         HERE NDIM IS EQUAL TO 5.
C
    9     AUX1=Y(4)+Y(4)
          AUX1=AUX1+AUX1
          Z(5)=SUM1+HT*(Y(3)+AUX1+Y(5))
C
C         HERE NDIM IS EQUAL TO 4.
C
   10     Z(3)=SUM1
          Z(4)=SUM2
          RETURN
C
C         HERE NDIM IS EQUAL TO 3.
C
   11     SUM1=HT*(1.25*Y(1)+Y(2)+Y(2)-0.25*Y(3))
          SUM2=Y(2)+Y(2)
          SUM2=SUM2+SUM2
          Z(3)=HT*(Y(1)+SUM2+Y(3))
          Z(1)=0.0
          Z(2)=SUM1
   12     RETURN
          END
```

4. SAMPLE INPUT DATA FILE

The next four pages present an input data file in punched-card-image format for use as a test case with the program statements of Section 3. The test case selected was run 378 from the DC-9 data analyzed in Volume I.

The data are stored in the order and with the format that they are read by program TESTREF. For the test case shown, there are 211 lines of data arranged as follows:

line nos.	description
1	RUN stored as I3
2	MIC, NS, DATE, MONTH, YEAR and stored as I1, I4, I3, 1A4, I3
3	TS, TOH, AH, ZH, AS, AM, GAMAD and stored as F7.1, F8.1, F6.1, F4.1, F5.1, F6.3, F5.1
4 to 143	SPL(I,J) where I = 1, NS and J = 1,24 and stored two lines at a time as 12F6.1 for NS data samples (here NS = 70 for 34.5 seconds of data starting at 0.0 seconds)
144	NH stored as I3
145 to 175	HM(K) where K = 1, NH and stored as F6.1 for NH data samples (here NH = 31)
176 to 206	TC(K), HR(K) where K = 1, NH and stored as 2F5.1 for the NH data samples
207	BP stored as F6.3
208	TITLE1 stored as 20A4
209	TITLE2 stored as 20A4
210	GROUND stored as 5A4
211	999 for the run number used to indicate the end of the data and to signal the program to STOP execution and END calculations

The symbols for the various data items described above are those used in the program statements and are defined in Section 2.

EXAMPLE INPUT DATA FILE

```
 line
number                                     Data

 1.000 378
 2.000 4  70 25 OCT 74
 3.000 44184.0 44199.7 158.0 1.2 72.6 0.212  0.0
 4.000      .0      .0      .0     .0     .0     .0     .0     .0   50.3   51.5     .0     .0
 5.000      .0    51.5    52.0   49.1   47.8   46.1   43.8   44.8   44.3     .0     .0     .0
 6.000      .0      .0      .0     .0     .0     .0     .0     .0   50.3     .0   48.0   50.6
 7.000      .0    50.6    50.6     .0   46.8   44.6   43.8   44.8   44.3     .0     .0     .0
 8.000      .0      .0      .0     .0     .0     .0     .0     .0     .0     .0   50.1   52.5
 9.000    48.8    50.3    51.3   48.1   48.1   43.3   43.8   44.8   44.3     .0     .0     .0
10.000      .0      .0      .0     .0     .0     .0     .0     .0     .0   52.6   55.1   55.1
11.000    48.8    50.6    52.0   53.0   51.1   44.1   43.8   44.8   44.3     .0     .0     .0
12.000      .0      .0      .0     .0     .0     .0     .0   52.8   51.3   52.6   54.6   53.8
13.000      .0    51.3    51.3   53.0   51.1   46.6   43.8   44.8   44.3     .0     .0     .0
14.000      .0      .0      .0     .0     .0     .0     .0   52.6   52.6   52.6   53.0   52.1
15.000      .0    49.8    52.0   54.3   55.8   50.5   46.1   44.8   44.3     .0     .0     .0
16.000      .0      .0      .0     .0     .0     .0   54.8   55.8   52.8   52.6   52.8   51.1
17.000    51.8    53.0    55.8   57.0   56.8   53.8   46.8   44.8   44.3     .0     .0     .0
18.000      .0      .0      .0     .0     .0     .0   59.1   59.6   57.1   54.6   49.8   49.8
19.000    51.1    54.6    55.3   55.1   56.3   50.8   46.3   44.8   44.3     .0     .0     .0
20.000      .0      .0      .0     .0     .0     .0   59.8   61.0   59.0   54.0   51.1     .0
21.000      .0    54.3    53.6   54.1   55.8   50.5   46.1   44.8   44.3     .0     .0     .0
22.000      .0      .0      .0     .0     .0   59.3   61.8   59.8   58.8   56.6   52.3   50.1
23.000    51.8    59.5    59.1   53.6   53.1   51.3   47.6   44.8   44.3     .0     .0     .0
24.000      .0      .0      .0     .0     .0   59.8   63.0   62.8   61.8   58.3   54.6   51.5
25.000    53.8    60.8    62.3   58.0   58.3   54.0   51.0   46.3   44.3     .0     .0     .0
26.000      .0      .0      .0     .0     .0   60.8   64.5   65.3   62.8   59.1   56.6   56.1
27.000    63.1    64.6    63.5   64.6   63.6   61.8   56.8   52.8   44.3     .0     .0     .0
28.000      .0      .0      .0     .0     .0   64.1   63.5   64.6   59.8   59.6   55.5   61.5
29.000    68.3    72.3    71.8   66.0   68.5   63.6   59.6   55.1   44.8     .0     .0     .0
30.000      .0      .0      .0     .0     .0   60.8   63.5   61.5   57.6   55.6   51.3   58.8
31.000    63.0 67.[illegible]  63.5   60.1   62.6   58.1   56.3   52.3   44.3     .0     .0     .0
32.000      .0 [illegible]      .0     .0   64.0   59.3   61.6   61.3   57.6   52.6   54.1   62.8
33.000    64.3    67.6    63.8   64.0   63.1   60.1   57.8   55.1   44.3     .0     .0     .0
34.000      .0      .0      .0     .0     .0   61.8   62.1   60.3   54.6     .0   51.3   60.1
35.000    63.1    64.6    60.5   66.0   64.1   59.3   57.1   57.3   45.1     .0     .0     .0
36.000      .0      .0      .0     .0     .0   60.1   62.1   61.0   54.6   48.3   58.6   61.8
37.000    61.1    59.5    62.8   62.6   61.6   58.3   55.1   57.6   44.5     .0     .0     .0
38.000      .0      .0      .0     .0     .0   60.1   63.5   61.3   55.0   57.6   64.8   64.8
39.000    65.3    62.3    64.5   62.8   60.8   58.1   56.8   58.3   45.8     .0     .0     .0
40.000      .0      .0      .0     .0   62.6   63.1   64.0   60.3   52.6   58.3   63.8   66.6
41.000    61.1    59.8    63.8   60.3   63.1   58.1   56.3   57.3   46.3     .0     .0     .0
42.000      .0      .0      .0     .0   64.0   64.3   59.3   57.1   52.1   61.8   63.3   64.8
43.000    60.1    65.6    64.5   62.8   61.8   59.1   56.8   58.6   47.1     .0     .0     .0
44.000      .0      .0      .0     .0   63.3   64.1   62.3   55.3   57.6   66.3   68.8   67.8
45.000    62.1    69.3    65.3   67.0   65.0   63.3   61.6   62.8   51.3     .0     .0     .0
46.000      .0      .0      .0   66.8   64.3   63.1   59.3   54.8   62.1   68.8   70.3   66.3
47.000    65.3    71.3    66.3   68.6   67.1   63.3   61.8   63.1   52.6     .0     .0     .0
48.000      .0      .0      .0   66.5   65.3   65.8   57.3   57.5   65.6   68.0   68.5   63.0
49.000    67.1    65.6    65.8   64.5   65.0   61.6   59.8   62.8   51.8     .0     .0     .0
50.000      .0      .0      .0   65.8   65.3   60.1   55.8   64.1   71.0   72.0   69.3   65.3
51.000    71.1    67.1    67.8   68.5   67.1   65.8   65.1   67.3   56.5     .0     .0     .0
52.000      .0      .0    69.1   67.1   67.0     .0   60.3   68.1   74.0   72.8   68.0   70.6
53.000    70.8    68.6    68.0   68.5   67.6   65.1   63.3   69.6   58.5     .0     .0     .0
54.000      .0      .0    68.6   66.8   62.6   60.8   68.3   71.5   72.0   69.3   66.5   71.8
```

55.000	67.6	69.6	67.5	66.6	67.5	64.1	64.3	67.6	59.6	50.0	.0	.0
56.000	.0	.0	69.1	65.8	.0	63.8	71.3	74.6	73.6	66.5	72.3	71.6
57.000	71.3	70.1	69.5	69.0	69.0	67.8	67.6	69.8	62.3	54.8	.0	.0
58.000	.0	.0	.0	.0	.0	69.6	75.6	73.5	70.1	70.5	74.0	69.8
59.000	71.3	70.6	69.0	69.5	67.6	67.3	67.1	70.6	62.6	56.1	.0	.0
60.000	.0	.0	.0	.0	69.6	71.5	75.3	75.1	70.5	78.8	76.5	75.6
61.000	74.3	74.1	74.3	74.1	73.5	72.3	73.8	78.1	69.6	63.3	57.8	.0
62.000	.0	.0	.0	.0	72.8	78.3	78.1	70.6	77.0	78.5	77.8	77.6
63.000	76.1	76.6	76.0	76.5	75.5	75.8	79.6	87.1	71.8	68.0	67.8	56.0
64.000	74.8	.0	.0	71.3	79.0	80.6	79.1	73.0	81.5	77.5	80.8	78.3
65.000	77.8	76.6	77.3	78.1	76.6	78.8	83.1	85.6	74.1	73.3	71.3	59.1
66.000	.0	.0	.0	76.0	82.0	81.3	77.1	80.6	83.0	80.0	80.8	81.8
67.000	80.3	79.3	79.8	79.5	77.6	79.8	85.6	82.3	78.6	76.8	73.3	62.6
68.000	.0	.0	67.8	78.0	81.6	83.8	77.1	85.0	83.1	83.5	81.8	81.8
69.000	80.8	80.3	80.8	80.0	79.0	81.6	86.6	82.3	80.8	79.0	74.8	66.3
70.000	.0	.0	69.3	80.0	84.0	83.1	76.6	84.0	85.0	85.0	82.3	83.6
71.000	82.8	81.1	81.3	79.5	79.1	82.8	88.1	84.1	82.8	80.3	76.8	67.6
72.000	76.0	.0	69.3	77.5	85.1	85.8	82.6	83.0	86.1	83.0	85.3	83.3
73.000	83.1	81.6	82.0	82.5	81.1	84.3	86.8	85.6	82.8	81.3	77.1	68.3
74.000	74.5	.0	.0	78.0	85.1	85.6	87.6	80.0	87.5	84.3	84.8	82.6
75.000	81.3	81.6	81.0	78.5	79.6	81.3	83.6	83.6	80.1	77.5	73.1	64.6
76.000	81.3	78.5	70.0	78.1	82.6	86.3	87.8	81.0	84.5	85.8	81.0	81.8
77.000	80.1	78.8	77.3	76.5	77.5	79.6	81.6	79.1	77.6	73.3	67.8	59.0
78.000	80.1	81.3	79.1	73.8	81.0	86.8	89.1	86.0	78.1	85.3	81.0	83.1
79.000	80.1	78.3	77.8	75.5	75.5	78.1	79.6	76.6	73.8	70.3	64.0	54.3
80.000	81.6	82.8	81.8	74.1	74.8	84.1	87.1	86.0	76.1	80.5	78.3	76.6
81.000	74.8	75.3	73.5	72.5	71.6	75.8	76.3	74.1	70.6	66.5	59.1	49.8
82.000	81.8	83.3	83.1	77.5	72.3	77.6	82.8	83.0	78.0	76.3	78.0	72.3
83.000	73.8	72.1	71.5	69.1	68.1	73.3	72.1	68.3	64.8	59.8	52.3	.0
84.000	84.5	84.6	86.0	79.1	71.0	76.1	82.1	82.5	79.0	72.8	79.3	76.8
85.000	75.3	72.3	71.5	70.5	69.6	75.8	73.3	70.8	67.3	61.8	54.1	.0
86.000	84.5	82.6	85.8	82.8	72.6	69.5	78.3	81.5	79.6	73.3	73.0	75.1
87.000	71.3	71.3	71.8	69.6	68.1	73.6	71.1	68.3	64.6	58.3	.0	.0
88.000	85.6	86.5	86.0	84.1	74.1	67.3	71.6	80.0	80.5	75.8	70.3	76.6
89.000	70.8	72.8	71.3	68.6	68.6	73.6	71.3	68.6	64.3	58.1	.0	.0
90.000	83.1	84.8	87.3	84.3	76.6	64.8	68.1	72.1	76.5	72.8	66.0	68.3
91.000	67.8	66.8	65.8	63.6	63.6	67.3	64.8	62.1	57.0	50.3	.0	.0
92.000	83.0	81.8	85.3	85.1	77.6	69.1	63.0	68.6	72.6	70.5	65.3	64.5
93.000	64.3	62.3	64.5	61.3	60.6	66.3	63.1	59.3	54.1	.0	.0	.0
94.000	82.1	85.6	85.8	81.8	79.6	70.0	59.3	63.3	69.6	69.0	65.8	59.8
95.000	61.1	58.5	60.5	57.8	58.1	60.8	58.1	53.8	49.1	.0	.0	.0
96.000	83.0	83.8	83.1	83.6	81.0	71.1	61.0	63.6	68.1	69.3	66.8	60.3
97.000	62.5	59.3	62.3	57.3	56.8	60.3	56.6	54.3	48.6	.0	.0	.0
98.000	78.8	79.8	82.8	82.6	80.5	73.1	62.1	62.8	68.6	69.5	69.0	62.5
99.000	62.0	61.5	58.8	56.8	56.0	59.6	56.3	51.6	47.3	.0	.0	.0
100.000	81.3	81.6	81.3	80.0	78.1	73.5	65.6	60.6	66.1	68.8	69.0	64.3
101.000	59.1	63.8	58.3	59.8	58.1	62.1	58.8	53.3	47.3	.0	.0	.0
102.000	79.3	82.1	84.0	82.6	78.5	73.5	67.1	59.1	69.0	71.5	70.8	66.8
103.000	60.6	66.3	64.0	64.6	63.6	66.1	62.1	56.3	49.8	.0	.0	.0
104.000	77.6	77.6	76.8	82.1	79.0	75.1	67.3	57.6	62.6	67.3	66.3	62.5
105.000	54.8	60.3	59.1	57.0	56.0	58.3	54.6	49.5	44.3	.0	.0	.0
106.000	77.6	75.3	79.8	78.5	75.8	71.0	66.1	57.6	59.3	63.3	66.8	64.0
107.000	55.8	55.6	59.8	51.3	53.3	57.1	54.3	47.5	44.3	.0	.0	.0
108.000	72.6	77.1	77.1	79.1	74.8	69.1	64.0	56.6	54.0	61.6	66.8	68.1
109.000	60.0	55.6	60.3	53.6	55.5	56.8	52.1	46.3	44.3	.0	.0	.0

BEST DOCUMENT AVAILABLE

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110.000   75.3   75.8   75.1   73.8   73.6   70.1   65.8   57.5   51.3   56.6   63.8   65.0
111.000   59.5   54.1   58.8   55.3   57.3   60.8   54.8   49.0   44.3     .0     .0     .0
112.000   73.3   76.0   77.1   74.6   72.6   68.8   65.3   56.8   50.8   54.8   64.3   66.3
113.000   63.0   55.1   58.3   54.6   54.6   55.8   53.3   45.3   44.3     .0     .0     .0
114.000   73.0   73.3   78.3   74.8   69.6   67.8   63.5   57.5   52.0   52.3   59.6   63.5
115.000   62.6   54.6   55.8   55.6   53.8   56.3   52.6   45.0   44.3     .0     .0     .0
116.000   74.1   72.8   74.1   73.0   70.5   65.1   61.0   58.8   51.6   49.6   58.1   61.0
117.000   62.1   55.1   54.1   54.1   48.1   53.0   49.1   44.8   44.3     .0     .0     .0
118.000     .0   71.6   70.6   70.6   71.5   64.8   57.6   57.1   51.3     .0   56.6   59.3
119.000   59.1   56.1   52.6   52.6     .0   51.0   47.6   44.8   44.3     .0     .0     .0
120.000     .0     .0   71.8   70.1   66.6   63.0   59.6   53.8   50.3     .0   52.5   57.8
121.000   57.6   54.1   48.8   48.3     .0   48.1   43.8   44.8   44.3     .0     .0     .0
122.000     .0     .0     .0   65.3   65.8   62.1     .0     .0     .0     .0   48.1   51.8
123.000   55.1   53.1   45.8     .0     .0   47.8   43.8   44.8   44.3     .0     .0     .0
124.000     .0     .0     .0   66.8     .0   59.8     .0     .0     .0     .0   47.3   50.6
125.000   51.8   51.8     .0     .0     .0   45.0   43.8   44.8   44.3     .0     .0     .0
126.000     .0     .0     .0   68.8   62.6     .0   55.1     .0     .0     .0     .0     .0
127.000   51.1   50.6   46.1     .0     .0   46.3   43.8   44.8   44.3     .0     .0     .0
128.000   71.8   70.8     .0   67.1   64.6   58.8     .0   52.6   51.3     .0     .0     .0
129.000   50.8   50.1   46.8     .0     .0   47.3   43.8   44.8   44.3     .0     .0     .0
130.000     .0     .0   72.8   68.6   63.0   61.3   56.1   52.6   52.6     .0     .0   50.6
131.000   52.6   52.6   50.0     .0     .0   47.1   43.8   44.8   44.3     .0     .0     .0
132.000     .0   71.5   69.3   68.6   68.1   64.3   61.0   56.6   56.6     .0     .0   52.6
133.000   50.6   50.3   48.8     .0     .0   43.8   43.8   44.8   44.3     .0     .0     .0
134.000   73.3     .0   68.5   69.5   66.3   64.6   58.8   58.0   55.6   50.3     .0     .0
135.000     .0     .0   47.6     .0     .0   43.3   43.8   44.8   44.3     .0     .0     .0
136.000   73.0     .0     .0     .0   62.6   61.3   55.1     .0   52.1   54.0     .0     .0
137.000   48.6   48.6   45.1     .0     .0   43.3   43.8   44.8   44.3     .0     .0     .0
138.000     .0     .0     .0     .0     .0     .0   54.8     .0     .0   48.6     .0     .0
139.000     .0   49.1   45.5     .0     .0   43.3   43.8   44.8   44.3     .0     .0     .0
140.000     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0
141.000     .0   51.3   48.6     .0     .0   43.3   43.8   44.8   44.3     .0     .0     .0
142.000     .0     .0     .0   65.8     .0     .0     .0     .0   51.3     .0     .0     .0
143.000   50.0   55.1   52.0     .0     .0   43.3   43.8   44.8   44.3     .0     .0     .0
144.000  31
145.000    1.2
146.000   30.5
147.000   61.0
148.000   91.5
149.000  122.0
150.000  152.5
151.000  183.0
152.000  213.5
153.000  244.0
154.000  274.5
155.000  305.0
156.000  335.5
157.000  366.0
158.000  396.5
159.000  427.0
160.000  457.5
161.000  488.0
162.000  518.5
163.000  549.0
164.000  579.5
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165.000  610.0
166.000  640.5
167.000  671.0
168.000  701.5
159.000  732.0
170.000  762.5
171.000  793.0
172.000  823.5
173.000  854.0
174.000  884.5
175.000  915.0
176.000  20.6 47.7
177.000  20.2 48.1
178.000  20.4 46.9
179.000  19.9 48.0
180.000  19.5 49.8
181.000  19.2 51.3
182.000  18.9 51.6
183.000  18.8 51.4
184.000  18.6 52.1
185.000  18.4 51.7
186.000  18.2 50.2
187.000  18.0 51.1
188.000  17.9 50.4
189.000  17.8 49.9
190.000  17.5 50.1
191.000  17.7 48.9
192.000  17.4 49.1
193.000  17.3 49.5
194.000  17.2 48.1
195.000  17.3 46.0
196.000  17.3 44.3
197.000  17.8 46.8
198.000  18.0 46.7
199.000  17.8 44.0
200.000  17.9 44.7
201.000  17.7 46.9
202.000  17.3 48.1
203.000  17.1 48.6
204.000  16.8 49.1
205.000  16.6 49.8
206.000  16.3 50.6
207.000 29.669
208.000         MEASURED TEST-DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
209.000         DC-9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL
210.000 CONCRETE
211.000 999
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5. SAMPLE OUTPUT LISTING

The next eight pages contain the listings of output data that resulted from running program TESTREF in Section 3 with the input data in Section 4. The output data are in the order and with the format specified by the WRITE and FORMAT statements in TESTREF.

The first five of the eight pages are called the data pages. They contain the test-day sound pressure levels [read from input-data array SPL(I,J)] at 0.5-s intervals for the 1/3-octave bands with center frequencies from 50 to 10,000 Hz. They also contain the test-day PNL, PNLT, and AL values. The center frequency, FMX in kHz, of the 1/3-octave-band sound pressure level that produced the largest tone-correction factor is also listed on the data pages. The magnitude of the tone-correction factor can be seen by subtracting the PNL from the PNLT value. A value of .0 for a sound pressure level means that the aircraft noise signal at that time for that band was not more than 5.0 dB greater than the corresponding background noise level (ambient noise + instrument noise).

The fifth, or final, data page also contains the values of the test-day PNLM, PNLTM, and ALM along with their relative times of occurrence. The value of the duration-correction factor, DCF, for the test-day EPNL is given with the relative times over which the PNLT integration was performed to find EPNL. Test-day EPNL is listed on the line below that with PNLM, PNLTM, and DCF. The last line on the fifth page contains ALM, SEL, and the relative times over which the AL values were integrated to find SEL.

The sixth page lists the test-day and reference-day meteorological data at the heights above ground level corresponding to the midpoints of the layers of the atmosphere defined by the heights in input data array HM(K). At the foot of the listings is the station barometric pressure; the air temperature, relative humidity, and molar concentration of water vapor interpolated at a height of 10.0 m from the actual measured data; and the corresponding uniform-atmosphere values for acoustical-reference-day conditions.

The final two pages contain the last two pages of summary output data. The seventh page contains the test-day SPLs at the time of occurrence of PNLTM, the corresponding reference-day SPLS adjusted by the four methods, and the corresponding PNL, PNLT, and EPNL values. The eighth page contains similar data except at the time of occurrence of ALM with corresponding reference-day values of AL and SEL. At the foot of each page is the height of the airplane over the microphone and the sound propagation pathlength and directivity angle at the time of the test-day PNLTM or ALM.

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RUN NO.: 378; MIC NO.: 4                                          DATA PAGE  1 OF  5

             MEASURED TEST DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
             DC-9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL

            TEST DATE: 25 OCT 74; MIC HT: 1.2 M; START TIME: 44184.0 S
    TIME OH: 44199.7 S; HT OH:  158.0 M; AIRSPEED OH: 72.6 M/S; GRND SURF: CONCRETE

CENTER           1/3-OCTAVE-BAND SOUND PRESSURE LEVEL, DB RE 20 MICROPASCALS
FREQ.,                            TIME RELATIVE TO START TIME, S
 HZ       .0    .5   1.0   1.5   2.0   2.5   3.0   3.5   4.0   4.5   5.0   5.5   6.0   6.5

   50     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
   63     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
   80     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0

  100     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
  125     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
  160     .0    .0    .0    .0    .0    .0    .0    .0    .0  59.3  59.8  60.8  64.1  60.8

  200     .0    .0    .0    .0    .0    .0  54.8  59.1  59.8  61.0  63.0  64.5  63.5  63.5
  250     .0    .0    .0    .0  52.8  52.6  55.8  59.6  61.0  59.8  62.8  65.3  64.6  61.5
  315   50.3  50.3    .0    .0  51.3  52.6  52.8  57.1  59.0  58.8  61.8  62.8  59.8  57.6

  400   51.5    .0    .0  52.6  52.6  52.6  52.6  54.6  54.0  56.6  58.3  59.1  59.6  55.6
  500     .0  48.0  50.1  55.1  54.6  53.0  52.8  49.8  51.1  52.3  54.6  56.6  55.5  51.3
  630     .0  50.6  52.5  55.1  53.8  52.1  51.1  49.8    .0  50.1  51.5  56.1  61.5  58.8

  800     .0    .0  48.8  48.8    .0    .0  51.8  51.1    .0  51.8  53.8  63.1  68.3  63.0
 1000   51.5  50.6  50.3  50.6  51.3  49.8  53.0  54.6  54.3  59.5  60.8  64.6  72.3  67.6
 1250   52.0  50.6  51.3  52.0  51.3  52.0  55.8  55.3  53.6  59.1  62.3  63.5  71.8  63.5

 1600   49.1    .0  48.1  53.0  53.0  54.3  57.0  55.1  54.1  53.6  58.0  64.6  66.0  60.1
 2000   47.8  46.8  48.1  51.1  51.1  55.8  56.8  56.3  55.8  53.1  58.3  63.6  60.5  62.6
 2500   46.1  44.6  43.3  44.1  46.6  50.5  53.8  50.8  50.5  51.3  54.0  61.8  63.6  58.1

 3150   43.8  43.8  43.8  43.8  43.8  46.1  46.8  46.3  46.1  47.6  51.0  56.8  59.6  56.3
 4000   44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  46.3  52.8  55.1  52.3
 5000   44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.8  44.3

 6300     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
 8000     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
10000     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0

PNL,DB  67.0  66.2  67.4  70.3  70.8  73.4  75.4  75.3  74.3  75.2  78.6  83.3  86.9  81.9
PNLT,DB 67.4  66.2  68.0  70.8  71.2  74.5  75.9  76.4  75.4  75.8  79.6  83.8  88.2  83.1
 AL,DB  58.6  57.6  58.9  61.2  61.1  62.3  64.5  64.1  63.4  65.6  68.4  72.7  77.9  72.2
FMX,KHZ 1.250  .050 2.000 2.000 1.600 2.000 2.500 2.000 2.000 1.250 1.250 4.000 2.000 2.000
        FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE 1/3-OCTAVE BAND THAT PRODUCES C(I)
 C(I) IS THE LARGEST OF THE TONE-CORRECTION FACTORS FOR THE CORRESPONDING SPECTRUM SPL(I,J)
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RUN NO.: 3791 MIC NO.: 4                                                DATA PAGE  2 OF  5

                  MEASURED TEST-DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
                  DC 9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL

                  TEST DATE: 25 OCT 74; MIC HT: 1.2 M; START TIME: 44184.0 S
       TIME OH: 44199.7 S; HT OH:  158.0 M; AIRSPEED OH: 72.6 M/S; GRND SURF: CONCRETE

CENTER             1/3-OCTAVE-BAND SOUND PRESSURE LEVEL, DB RE 20 MICROPASCALS
FREQ.,                              TIME RELATIVE TO START TIME, S
  HZ      7.0    7.5    8.0    8.5    9.0    9.5   10.0   10.5   11.0   11.5   12.0   12.5   13.0   13.5

   50      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0
   63      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0
   80      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0   69.1   68.6   69.1     .0

  100      .0     .0     .0     .0     .0     .0     .0   66.8   66.5   65.8   67.1   66.8   65.8     .0
  125    64.0     .0     .0     .0   62.6   64.0   63.3   64.3   65.3   65.3   67.0   62.6     .0     .0
  160    59.3   61.8   60.1   60.1   63.1   64.3   64.1   63.1   65.8   60.1     .0   60.8   63.8   69.6

  200    61.6   62.1   62.1   63.5   64.0   59.3   62.3   59.3   57.3   55.8   60.3   68.3   71.3   75.6
  250    61.3   60.3   61.0   61.3   60.3   57.1   55.3   54.8   57.5   64.1   68.1   71.5   74.6   73.5
  315    57.6   54.6   54.6   55.0   52.6   52.1   57.6   62.1   65.6   71.0   74.0   72.0   73.6   70.1

  400    52.6     .0   48.3   57.6   58.3   61.8   66.3   68.8   68.0   72.0   72.8   69.3   66.5   70.5
  500    54.1   51.3   50.6   64.8   63.8   63.3   68.8   70.3   68.5   69.3   68.0   66.5   72.3   74.0
  630    62.8   60.1   61.8   64.8   66.6   64.8   67.8   66.3   63.0   65.3   70.6   71.8   71.6   69.8

  800    64.3   63.1   61.1   65.3   61.1   60.1   62.1   65.3   67.1   71.1   70.8   67.6   71.3   71.3
 1000    67.6   64.6   59.5   62.3   59.8   65.6   69.3   71.3   65.6   67.1   68.6   69.6   70.1   70.6
 1250    63.8   60.5   62.8   64.5   63.8   64.5   65.3   66.3   65.8   67.8   68.0   67.5   69.5   69.0

 1600    64.0   66.0   62.6   62.8   60.3   62.8   67.0   68.6   64.5   68.5   68.5   66.6   69.0   69.5
 2000    63.1   64.1   61.6   60.8   63.1   61.8   65.0   67.1   65.0   67.1   67.6   67.5   69.0   67.6
 2500    60.1   59.3   58.3   58.1   58.1   59.1   63.3   63.3   61.6   65.8   65.1   64.1   67.8   67.3

 3150    57.8   57.1   55.1   56.8   56.3   56.8   61.6   61.8   59.8   65.1   63.3   64.3   67.6   67.4
 4000    55.1   57.3   57.6   58.3   57.3   58.6   62.8   63.1   62.8   67.3   67.6   67.6   69.8   70.6
 5000    44.3   45.1   44.5   45.8   46.3   47.1   51.3   52.6   51.8   54.5   58.5   59.6   62.3   62.6

 6300      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0   50.0   54.8   56.1
 8000      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0
10000      .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0     .0

PNL,DB   83.1   82.6   81.4   82.3   83.0   82.8   84.4   87.8   86.5   90.1   91.6   91.0   93.0   93.2
PNLT,DB  84.0   84.7   84.0   84.7   85.0   85.0   88.5   89.7   88.8   92.2   94.5   92.8   94.6   95.1
AL,DB    73.3   72.5   70.9   72.6   72.0   72.7   76.1   77.5   75.3   78.4   79.2   78.4   80.5   80.5
FMX,KHZ 4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000  4.000
        FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE 1/3 OCTAVE BAND THAT PRODUCES C(I)
  C(I) IS THE LARGEST OF THE TONE-CORRECTION FACTORS FOR THE CORRESPONDING SPECTRUM SPL(I,J)
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RUN NO.: 370; MIC NO.: 4                                                        DATA PAGE  3 OF  5

                        MEASURED TEST-DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
                        DC-9-10/JT8D : FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL

                        TEST DATE: 25 OCT 74; MIC HT: 1.2 M; START TIME: 44184.0 S
         TIME OH: 44197.7 S; HT OH:  158.0 M; AIRSPEED OH: 72.6 M/S; GRND SURF: CONCRETE

CENTER                1/3 OCTAVE-BAND SOUND PRESSURE LEVEL, DB RE 20 MICROPASCALS
FREQ.,                                  TIME RELATIVE TO START TIME, S
  HZ     14.0  14.5  15.0  15.5  16.0  16.5  17.0  17.5  18.0  18.5  19.0  19.5  20.0  20.5

    50     .0    .0  74.8    .0    .0    .0  76.0  74.5  81.3  80.1  81.6  81.8  84.5  84.5
    63     .0    .0    .0    .0    .0    .0    .0    .0  78.5  81.3  82.8  83.3  84.6  82.6
    80     .0    .0    .0    .0  67.8  69.3  69.3    .0  70.0  79.1  81.8  83.1  86.0  85.8

   100     .0    .0  71.3  76.0  78.0  80.0  77.5  78.0  78.1  73.8  74.1  77.5  79.1  82.8
   125   69.6  72.8  79.0  82.0  81.6  84.0  85.1  85.1  82.6  81.0  74.8  72.3  71.0  72.6
   160   71.5  78.3  80.6  81.3  83.8  83.1  85.8  85.6  86.3  86.8  84.1  77.6  76.1  69.5

   200   75.3  78.1  79.1  77.1  77.1  76.6  82.6  87.6  87.8  89.1  87.1  82.8  82.1  78.3
   250   75.1  70.6  73.0  80.6  85.0  84.0  83.0  80.0  81.0  86.0  86.0  83.0  82.5  81.5
   315   70.5  77.0  81.5  83.0  83.1  85.0  86.1  87.5  84.5  78.1  76.1  78.0  79.0  79.6

   400   78.8  78.5  77.5  80.0  83.5  85.0  83.0  84.3  85.8  85.3  80.5  76.3  72.8  73.3
   500   76.5  77.8  80.8  80.8  81.8  82.3  85.3  84.8  81.0  81.0  78.3  78.0  79.3  73.0
   630   75.6  77.6  78.3  81.8  81.8  83.6  83.3  82.6  82.8  83.1  76.6  72.3  76.8  75.1

   800   74.3  76.1  77.8  80.3  80.8  82.8  83.1  81.3  80.1  80.1  74.8  73.8  75.3  71.3
  1000   74.1  76.6  76.6  79.3  80.3  81.1  81.6  81.6  78.8  78.3  75.3  72.1  72.3  71.3
  1250   74.3  76.0  77.3  79.8  80.8  81.3  82.0  81.0  77.3  77.8  73.5  71.5  71.5  71.8

  1600   74.1  76.5  78.1  79.5  80.0  79.5  82.5  78.5  76.5  75.5  72.5  69.1  70.5  69.6
  2000   73.5  75.5  76.6  77.6  79.0  79.1  81.1  79.6  77.5  75.5  71.6  68.1  69.6  68.1
  2500   72.3  75.8  78.8  79.8  81.6  82.8  84.3  81.3  79.6  78.1  75.8  73.3  75.8  73.6

  3150   73.8  79.6  83.1  85.6  86.6  88.1  86.8  83.6  81.6  79.6  76.3  72.1  73.3  71.1
  4000   78.1  87.1  85.6  82.3  82.3  84.1  85.6  83.6  79.1  76.6  74.1  68.3  70.8  68.3
  5000   67.6  71.8  74.1  78.6  80.8  82.8  82.8  80.1  77.6  73.8  70.6  64.8  67.3  64.6

  6300   63.3  68.0  73.3  76.8  79.0  80.3  81.3  77.5  73.3  70.3  66.5  59.8  61.8  58.3
  8000   57.8  67.8  71.3  73.1  74.8  76.8  77.1  73.1  67.8  64.0  59.1  52.3  54.1    .0
 10000     .0  56.0  59.1  62.6  66.3  67.6  68.3  64.6  59.0  54.3  49.8    .0    .0    .0

PNL,DB   99.5 105.7 106.2 107.1 108.3 109.6 109.6 107.4 105.6 104.3 101.3  98.0  99.6  97.6
PNLT,DB 101.6 109.5 108.5 108.6 109.9 111.1 110.0 107.8 106.1 104.8 102.0  99.1 101.0  98.9
  AL,DB  85.2  90.2  91.3  92.3  93.4  94.6  95.1  93.3  91.1  90.3  87.0  84.0  85.2  83.2
FMX,KHZ 4.000 4.000 4.000 3.150 3.150 3.150 3.150 4.000 3.150 3.150 2.500 2.500 2.500 2.500
        FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE 1/3-OCTAVE BAND THAT PRODUCES C(I)
  C(I) IS THE LARGEST OF THE TONE-CORRECTION FACTORS FOR THE CORRESPONDING SPECTRUM SPL(I,J)
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RUN NO.: 378; MIC NO.: 4 DATA PAGE 4 OF 5

MEASURED TEST-DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
DC-9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL

TEST DATE: 25 OCT 74; MIC HT: 1.2 M; START TIME: 44184.0 S
TIME OH: 44199.7 S; HT OH: 158.0 M; AIRSPEED OH: 72.6 M/S; GRND SURF: CONCRETE

1/3-OCTAVE-BAND SOUND PRESSURE LEVEL, DB RE 20 MICROPASCALS
TIME RELATIVE TO START TIME, S

CENTER FREQ., HZ	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5
50	85.6	83.1	83.0	82.1	83.0	78.8	81.3	79.3	77.6	77.6	72.6	75.3	73.3	73.0
63	86.5	84.8	81.8	85.6	83.8	79.8	81.6	82.1	77.6	75.3	77.1	75.8	76.0	73.3
80	86.0	87.3	85.3	85.8	83.1	82.8	81.3	84.0	76.8	79.8	77.1	75.1	77.1	78.3
100	84.1	84.3	85.1	81.8	83.6	82.6	80.0	82.6	82.1	78.5	79.1	73.8	74.6	74.8
125	74.1	76.6	77.6	79.6	81.0	80.5	78.1	78.5	79.0	75.8	74.8	73.6	72.6	69.6
160	67.3	64.8	69.1	70.0	71.1	73.1	73.5	73.5	75.1	71.0	69.1	70.1	68.8	67.8
200	71.6	68.1	63.0	59.3	61.0	62.1	65.6	67.1	67.3	66.1	64.0	65.8	65.3	63.5
250	80.0	72.1	68.6	63.3	63.6	62.8	60.6	59.1	57.6	57.6	56.6	57.5	56.8	57.5
315	80.5	76.5	72.6	69.6	68.1	68.6	66.1	69.0	62.6	59.3	54.0	51.3	50.8	52.0
400	75.8	72.8	70.5	69.0	69.3	69.5	68.8	71.5	67.3	63.3	61.6	56.6	54.8	52.3
500	70.3	66.0	65.3	65.8	66.8	69.0	69.0	70.8	66.3	66.8	66.8	63.8	64.3	59.6
630	76.6	68.3	64.5	59.8	60.3	62.5	64.3	66.8	62.5	64.0	68.1	65.0	66.3	63.5
800	70.8	67.8	64.3	61.1	62.5	62.0	59.1	60.6	54.8	55.8	60.0	59.5	63.0	62.6
1000	72.8	66.8	62.3	58.5	59.3	61.5	63.8	66.3	60.3	55.6	55.6	54.1	55.1	54.6
1250	71.3	65.8	64.5	60.5	62.3	58.8	58.3	64.0	59.1	59.8	60.3	58.8	58.3	55.8
1600	68.6	63.6	61.3	57.8	57.3	56.8	59.8	64.6	57.0	51.3	53.6	55.3	54.6	55.6
2000	68.6	63.6	60.6	58.1	56.8	56.0	58.1	63.6	56.0	53.3	55.5	57.3	54.6	53.8
2500	73.6	67.3	66.3	60.8	60.3	59.6	62.1	66.1	58.3	57.1	56.8	60.8	55.8	56.3
3150	71.3	64.8	63.1	58.1	56.6	56.3	58.8	62.1	54.6	54.3	52.1	54.8	53.3	52.6
4000	68.6	62.1	59.3	53.8	54.3	51.6	53.3	56.3	49.5	47.5	46.3	49.0	45.3	45.0
5000	64.3	57.0	54.1	49.1	48.6	47.3	47.3	49.8	44.3	44.3	44.3	44.3	44.3	44.3
6300	58.1	50.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
PNL,DB	97.7	93.2	91.6	89.6	89.6	88.8	88.2	90.7	87.5	85.0	85.0	84.2	82.4	82.0
PNLT,DB	98.9	94.2	93.[illegible]	90.5	91.0	90.0	89.4	91.8	88.5	87.1	86.9	85.7	83.6	83.0
AL,DB	83.4	78.3	76.1	73.6	73.8	73.8	73.8	76.6	72.2	70.7	71.4	70.2	70.2	68.7
FMX,KHZ	2.500	2.500	2.500	2.500	1.250	2.500	2.500	2.500	2.500	1.250	1.250	2.500	1.250	2.500

FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE 1/3-OCTAVE BAND THAT PRODUCES C(I)
C(I) IS THE LARGEST OF THE TONE-CORRECTION FACTORS FOR THE CORRESPONDING SPECTRUM SPL(I,J)

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RUN NO.: 378; MIC NO.: 4                                                DATA PAGE  5 OF  5
                MEASURED TEST-DAY NOISE DATA FOR COMMERCIAL JET TRANSPORT
                DC 9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL

                TEST DATE: 25 OCT 74; MIC HT: 1.2 M; START TIME: 44184.0 S
      TIME OH: 44199.7 S; HT OH:  158.0 M; AIRSPEED OH: 72.6 M/S; GRND SURF: CONCRETE

CENTER              1/3-OCTAVE-BAND SOUND PRESSURE LEVEL, DB RE 20 MICROPASCALS
FREQ.,                               TIME RELATIVE TO START TIME, S
  HZ     28.0  28.5  29.0  29.5  30.0  30.5  31.0  31.5  32.0  32.5  33.0  33.5  34.0  34.5

    50   74.1    .0    .0    .0    .0    .0  71.8    .0    .0  73.3  73.0    .0    .0    .0
    63   72.8  71.6    .0    .0    .0    .0  70.8    .0  71.5    .0    .0    .0    .0    .0
    80   74.1  70.6  71.8    .0    .0    .0    .0  72.8  69.3  68.5    .0    .0    .0    .0

   100   73.0  70.6  70.1  65.3  66.8  68.8  67.1  68.6  68.6  69.5    .0    .0    .0  65.8
   125   70.5  71.5  66.6  65.8    .0  62.6  64.6  63.0  68.1  66.3  62.6    .0    .0    .0
   160   65.1  64.8  63.0  62.1  59.8    .0  58.8  61.3  64.3  64.6  61.3    .0    .0    .0

   200   61.0  57.6  59.6    .0    .0  55.1    .0  56.1  61.0  58.8  55.1  54.8    .0    .0
   250   58.8  57.1  53.8    .0    .0    .0  52.6  52.6  56.6  58.0    .0    .0    .0    .0
   315   51.6  51.3  50.3    .0    .0    .0  51.3  52.6  56.6  55.6  52.1    .0    .0  51.3

   400   49.6    .0    .0    .0    .0    .0    .0    .0    .0  50.3  54.0  48.6    .0    .0
   500   58.1  56.6  52.5  48.1  47.3    .0    .0    .0    .0    .0    .0    .0    .0    .0
   630   61.0  59.3  57.8  51.8  50.6    .0    .0  50.6  52.6    .0    .0    .0    .0    .0

   800   62.1  59.1  57.6  55.1  51.8  51.1  50.8  52.6  50.6    .0  48.6    .0    .0  50.0
  1000   55.1  56.1  54.1  53.1  51.8  50.6  50.1  52.6  50.3    .0  48.6  49.1  51.3  55.1
  1250   54.1  52.6  48.8  45.8    .0  46.1  46.8  50.0  48.8  47.6  45.1  45.5  48.6  52.0

  1600   54.1  52.6  48.3    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
  2000   48.1    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
  2500   53.0  51.0  48.1  47.8  45.0  46.3  47.3  47.1  43.8  43.3  43.3  43.3  43.3  43.3

  3150   49.1  47.6  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8  43.8
  4000   44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8  44.8
  5000   44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3  44.3

  6300     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
  8000     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
 10000     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0

PNL,DB   79.9  77.6  74.8  69.5  67.1  68.3  70.1  72.6  73.6  72.3  68.3  64.0  62.7  65.9
PNLT,DB  81.3  77.6  74.8  67.5  67.1  68.3  70.1  72.6  73.6  72.3  68.3  64.0  62.7  65.9
 AL,DB   67.1  65.4  63.3  60.2  57.9  57.7  58.4  60.4  61.0  59.4  57.6  54.8  55.4  57.0
FMX,KHZ 2.500  .050  .050  .050  .050  .050  .050  .050  .050  .050  .050  .050  .050  .050
      FMX IS THE CENTER FREQUENCY, IN KHZ, OF THE 1/3 OCTAVE BAND THAT PRODUCES C(I)
 C(I) IS THE LARGEST OF THE TONE-CORRECTION FACTORS FOR THE CORRESPONDING SPECTRUM SPL(I,J)

PNLM= 109.6 DB AT 17.0 S; PNLTM= 111.1 DB AT 16.5 S; DCF= -5.6 DB FROM 14.0 TO 19.0 S
EPNL=PNLTM+DCF= 105.6 DB
ALM=  95.1 DB AT 17.0 S; SEL=  99.7 DB; TSEL FROM  14.0 TO  20.0 S
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RUN NO.: 378; MIC NO.: 4 METEOROLOGICAL DATA PAGE 1 OF SUMMARY

HEIGHT AT MIDPOINT OF INTERVAL, M	MEAS. TEMP. OVER HEIGHT INTERVAL, C	MEAS. R.H. OVER HEIGHT INTERVAL, PCT.	MEAS. MOLAR CONC. OF WATER VAPOR, PCT.	REF. TEMP. AT MID. OF INTERVAL, C	REF. R.H. AT MID. OF INTERVAL, PCT.	REF. MOLAR CONC. OF WATER VAPOR, PCT.
15.8	20.4	47.9	1.142	25.0	70.0	2.186
45.8	20.3	47.5	1.126	24.8	69.8	2.162
76.3	20.1	47.4	1.114	24.6	67.6	2.138
106.8	19.7	48.9	1.116	24.4	69.4	2.115
137.3	19.3	50.6	1.129	24.2	69.2	2.091
167.8	19.0	51.4	1.128	24.0	69.0	2.068
198.3	18.8	51.5	1.115	23.8	68.8	2.045
228.8	18.7	51.8	1.110	23.6	68.6	2.022
259.3	18.5	51.9	1.100	23.4	68.4	2.000
289.8	18.3	50.9	1.066	23.2	68.2	1.978
320.3	18.1	50.6	1.046	23.0	68.0	1.955
350.8	17.9	50.8	1.039	22.8	67.8	1.933
381.3	17.8	50.1	1.020	22.6	67.6	1.912
411.8	17.6	50.0	1.004	22.4	67.4	1.890
442.3	17.6	49.5	.991	22.2	67.2	1.869
472.8	17.5	49.0	.978	22.0	67.0	1.848
503.3	17.3	49.3	.971	21.8	66.8	1.827
533.8	17.3	48.8	.956	21.6	66.6	1.806
564.3	17.3	47.1	.921	21.4	66.4	1.785
594.8	17.3	45.1	.887	21.2	66.2	1.765
625.3	17.5	45.6	.909	21.0	66.0	1.745
655.8	17.9	46.8	.954	20.8	65.8	1.725
686.3	17.9	45.3	.925	20.6	65.6	1.705
716.8	17.8	44.3	.902	20.4	65.4	1.685
747.3	17.8	45.8	.929	20.2	65.2	1.666
777.8	17.5	47.5	.945	20.0	65.0	1.647
808.3	17.2	48.4	.944	19.8	64.8	1.627
838.8	16.9	48.9	.939	19.6	64.6	1.609
869.3	16.7	49.4	.935	19.4	64.4	1.590
899.8	16.4	50.2	.934	19.2	64.2	1.571

STATION BAROMETRIC PRESSURE = 100.472 KPA (.992 STD. ATM.)

AT 10 M: MEAS. AIR TEMP.= 20.5 DEG C; MEAS. REL. HUM.= 47.8 PCT; MEAS. MOLAR CONC.= 1.146 PCT
REF.AIR TEMP.= 25.0 DEG C; REF. REL. HUM.= 70.0 PCT; REF. MOLAR CONC.= 2.18774 PCT

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RUN NO.: 378; MIC NO.: 4             PNL AND EPNL             PAGE 2 OF SUMMARY

          TEST-DAY NOISE DATA ADJUSTED TO ACOUSTICAL REFERENCE-DAY CONDITIONS
               DC-9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL
        REF.-DAY COND.: AIR TEMP = 25.0 C; REL HUM = 70.0 PCT; PRESS = 1.0 STD ATM

  BAND    (A)     (B)     (C)     (D)     (E)
 CENTER   TEST    ADJ.    ADJ.    ADJ.    ADJ
 FREQ.,   SPL,    SPL,    SPL,    SPL,    SPL,
   HZ      DB      DB      DB      DB      DB

     50     .0      .0      .0      .0      .0                COLUMN CODES:
     63     .0      .0      .0      .0      .0
     80   69.3    69.3    69.3    69.3    69.3       (A)TEST-DAY SPLS AT TIME OF TEST-DAY PNLTM &
                                                        ASSOCIATED INTEGRATED NOISE MEASURES.
    100   80.0    80.0    80.0    80.0    80.0
    125   84.0    84.0    84.0    84.0    84.0       THEN, TEST-DAY SPLS ADJUSTED TO ACOUSTICAL
    160   83.1    83.1    83.1    83.1    83.1       REFERENCE-DAY CONDITIONS & ASSOCIATED
                                                     MEASURES.  ADJUSTMENTS MADE USING:
    200   76.6    76.6    76.6    76.6    76.6
    250   84.0    84.0    84.0    84.1    84.1        (B)10-M MET. DATA AND SAE ARP 866A;
    315   85.0    85.0    85.0    85.1    85.1        (C)LAYERED MET. DATA ALOFT AND SAE ARP 866A;
                                                      (D)LAYERED MET. DATA ALOFT AND ABSORPTION BY
    400   85.0    85.0    85.0    85.0    85.0           ANS S1.26-1978 INTEGRATED OVER PASSBAND;
    500   82.3    82.3    82.3    82.3    82.3        (E)LAYERED MET. DATA ALOFT AND ABSORPTION BY
    630   83.6    83.6    83.5    83.5    83.5           ANS S1.26-1978 AT BAND CENT. FREQ. ONLY.

    800   82.8    82.7    82.7    82.6    82.6
   1000   81.1    81.0    81.0    80.9    80.9
   1250   81.3    81.2    81.2    81.0    81.0

   1600   79.5    79.4    79.4    79.2    79.2
   2000   79.1    79.0    79.0    78.9    78.9
   2500   82.8    82.8    82.8    82.8    82.8

   3150   88.1    88.3    88.3    88.5    88.5
   4000   84.1    84.7    84.7    85.1    85.1
   5000   82.8    83.8    83.8    84.8    84.8

   6300   80.3    82.3    82.3    83.8    83.8
   8000   76.8    80.4    80.5    82.4    82.6
  10000   67.6    73.6    73.7    76.4    76.9


 PNL,DB  109.6   110.0   110.0   110.3   110.3
PNLT,DB  111.1   111.5   111.5   111.8   111.8
EPNL,DB  105.6   105.9   105.9   106.2   106.2
FMX,KHZ          3.150   3.150   3.150   3.150

          AIRPLANE HEIGHT OVER MICROPHONE =  156.8 M
          SOUND PROPAGATION PATHLENGTH FOR TEST SPLS AT PNLTM =  162.3 M
          SOUND PROPAGATION ANGLE RELATIVE TO DIRECTION OF FLIGHT = 105.0 DEG AT PNLTM
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RUN NO.: 3781 MIC NO.: 4                 AL AND SEL                PAGE 3 OF SUMMARY

          TEST-DAY NOISE DATA ADJUSTED TO ACOUSTICAL REFERENCE-DAY CONDITIONS
                 DC-9-10/JT8D-1 FLYOVER NOISE TESTS AT FRESNO AIR TERMINAL
       REF.-DAY COND.: AIR TEMP = 25.0 C; REL HUM = 70.0 PCT; PRESS = 1.0 STD ATM

  BAND    (A)     (B)     (C)     (D)     (E)
CENTER   TEST    ADJ.    ADJ.    ADJ.    ADJ
FREQ.,   SPL,    SPL,    SPL,    SPL,    SPL,
  HZ      DB      DB      DB      DB      DB
                                                                 COLUMN CODES:
     50  76.0    76.0    76.0    76.0    76.0
     63    .0      .0      .0      .0      .0
     80  69.3    69.3    69.3    69.3    69.3         (A)TEST-DAY SPLS AT TIME OF TEST-DAY ALM &
                                                         ASSOCIATED INTEGRATED NOISE MEASURES.
    100  77.5    77.5    77.5    77.5    77.5
    125  85.1    85.1    85.1    85.1    85.1         THEN, TEST-DAY SPLS ADJUSTED TO ACOUSTICAL
    160  85.8    85.8    85.8    85.8    85.8         REFERENCE-DAY CONDITIONS & ASSOCIATED
                                                      MEASURES.  ADJUSTMENTS MADE USING:
    200  82.6    82.6    82.6    82.6    82.6
    250  83.0    83.0    83.0    83.1    83.1          (B)10-M MET. DATA AND SAE ARP 866A;
    315  86.1    86.1    86.1    86.2    86.2          (C)LAYERED MET. DATA ALOFT AND SAE ARP 866A;
                                                       (D)LAYERED MET. DATA ALOFT AND ABSORPTION BY
    400  83.0    83.0    83.0    83.0    83.0             ANS S1.26-1978 INTEGRATED OVER PASSBAND;
    500  85.3    85.3    85.3    85.3    85.3          (E)LAYERED MET. DATA ALOFT AND ABSORPTION BY
    630  83.3    83.2    83.2    83.2    83.2             ANS S1.26 1978 AT BAND CENT. FREQ. ONLY.

    800  83.1    83.0    83.0    82.9    82.9
   1000  81.6    81.5    81.5    81.3    81.3
   1250  82.0    81.9    81.9    81.7    81.7

   1600  82.5    82.4    82.3    82.2    82.2
   2000  81.1    81.0    81.0    80.9    80.9
   2500  84.3    84.3    84.3    84.3    84.3

   3150  86.8    87.0    87.0    87.2    87.2
   4000  85.6    86.3    86.3    86.6    86.6
   5000  82.8    83.8    81.9    84.9    84.9

   6300  81.3    83.4    83.5    85.0    85.1
   8000  77.1    81.0    81.1    83.1    83.4
  10000  68.3    74.8    74.8    77.8    78.3


 AL,DB   95.1    95.5    95.5    95.9    95.9
SEL,DB   99.7   100.0   100.1   100.4   100.4

            AIRPLANE HEIGHT OVER MICROPHONE -  154.8 M
            SOUND PROPAGATION PATHLENGTH FOR TEST SPLS AT ALM -   174.1 M
            SOUND PROPAGATION ANGLE RELATIVE TO DIRECTION OF FLIGHT - 115.8 DEG AT ALM
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